Message from the Editor-in-Chief

Dear Readers,

I am happy to inform you that the Turkish Online Journal of Educational Technology (TOJET) has been published second issue in 2011. This issue covered the selected papers from APTEL-2010 (Asia-Pacific Conference on Technology Enhanced Learning was held in Kansai University in Japan).

TOJET is interested in various researches in education in order to diffuse and share the knowledge with academic community. The journal promotes knowledge sharing in the academic and professional agendas within multi-dimensional angles. Exploring professional issues through different research approaches allow researchers, practitioners and students to reconstruct knowledge from relevant theories and techniques. Therefore, I am pleased to publish this issue issue which different papers from various fields are shared with professionals.

We have four guest editors for this issue. First guest editor is Prof. Dr. Teresa Franklin from Ohio University USA. She had reviewed normal submission papers.

Other three guest editors are from APTEL-2010 conference. These are Prof. Dr. Nian-Shing Chen Taiwan, Prof. Dr. Gwo-Jen Hwang from National Taiwan University of Science and Technology Taiwan, Assoc. Prof. Dr. Ju-Ling Shih from National University of Taiwan.

TOJET thanks and appreciate guest editors and the editorial board who have acted as reviewers for one or more submissions of this issue for their valuable contributions.

And as you know TOJET will organize IETC 2011 (International Educational Technology Conference – 2011 www.iet-c.net) at Istanbul University between May, 25-27 2011. IETC series is an international educational activity for academics, teachers and educators. This conference is now a well known educational technology event. It promotes the development and dissemination of theoretical knowledge, conceptual research, and professional knowledge through conference activities. Its focus is to create and disseminate knowledge about the use of instructional technology for learning and teaching in education.

We are pleased to announce that the presented papers at IETC 2011 will be reviewed for the July, 2011 and October, 2011 issues of TOJET.

Call for Papers
TOJET invites article contributions. Submitted articles should be about all aspects of educational technology. The articles should be original, unpublished, and not in consideration for publication elsewhere at the time of submission to TOJET.

April 01, 2011

Prof. Dr. Aytekin İŞMAN
Editor-in-Chief of TOJET
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A GAME-BASED LEARNING APPROACH TO IMPROVING STUDENTS’ LEARNING ACHIEVEMENTS IN A NUTRITION COURSE

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ABSTRACT
The aim of this study was to explore the influence of applying a game-based learning approach to nutrition education. The quasi-experimental nonequivalent-control group design was adopted in a four-week learning activity. The participants included sixty-six third graders in two classes of an elementary school. One of the classes was assigned to be the experimental group and the other was the control group. The experimental group learned with computer games, while the control group learned with the traditional teaching approach. The result showed that the learning achievement of the students in the experimental group was significantly better than that of the students in the control group. Similar results were obtained in terms of the learning interest of the students. Moreover, most of the students revealed quite positive attitudes toward the use of the game-based learning approach in nutrition education. An in-depth analysis showed that there was no significant difference between genders in terms of nutrition knowledge and learning attitudes.

Keywords: game-based learning, computer-assisted learning, nutrition education, learning achievements

INTRODUCTION
With the fast development of information technology and rapid social change in the twenty-first century, the growing economy, higher education level and progress of medicine is gradually turning people’s attention to health concepts and problems. Shaping healthy habits has become very important (Underbakke, McBride, & Spencer, 2006). Alexander (1994) held the view that healthy habits should be formed as early as possible. Therefore, to shape learners to have correct food and drink habits and establish a balanced diet, nutrition education needs be carried out in the early stages of school. The objective of health education is behavioral implementation, during which health concepts are acquired to form personal values. It is paramount in teaching to shape student values that can influence attitudes and behaviors.

Nutrition education has been recognized as a crucial factor in promoting good health. Researchers have indicated that healthy eating habits need to be shaped in childhood because unhealthy eating habits not only influence the normal growth of students, but also advance chronic diseases (Hang et al., 2009). Baranowski, Perry and Parcel (1997) stated that nutrition education should be a kind of experience learning, through which eating habits and nutrition knowledge can be changed. School students spend a long time at school, so the school environment can have a certain degree of influence on them. Shannon and Chen (1988) pointed out that the nutrition knowledge and attitudes of the students who take related courses are better than those of students who do not take the courses. Skinner and Woodburn (1983) also found that there is a positive correlation between the teaching of teachers’ nutrition courses and change in the nutrition knowledge, attitudes and behaviors of students. Several reports have also shown that the implementation of nutrition education for is helpful in improving their eating habits (Jensen, 1985; Smith & James, 1980); in the meantime, scholars have also indicated the difficulty of conducting effective nutrition learning activities since most students show low interest in nutrition and health courses (Chu, Hwang, Tseng, & Hwang, 2006; Howison, Niedermyer, & Shortridge, 1988; Carton, Kicklighter, Jonnalagadda, & Shoffner, 2000). Therefore, it becomes an important and challenging issue to educate children...
Several previous studies have demonstrated the ease of use and usefulness features of computer games by students can not only have better learning achievements, but also learn happily via these games. Therefore, if teachers are able to apply computer games to teaching, students can be increased, and their competences and knowledge can be promoted. Papastergiou (2009b) also pointed out that through computer games, children’s learning interests are effectively promoted, and they are stimulated to actively improve their food and drink habits.

LITERATURE REVIEW
Games have been recognized as being a good tool to promote learners to actively participate in learning activities (Alessi & Trollip, 1984; Baid & Lambert, 2010; Kirikkaya, İŞERİ, & Yurkaya, 2010; Huizenga, Akkerman, Admiraal, & Dam, 2009). Researchers have indicated that game-based learning could be the best way to trigger students’ learning motivation (Provost, 1990; Papastergiou, 2009a; Dickey, 2010; Huang, 2010; Tüzün, Yılmaz-Soylu, Karakuş, İnal, & Kızılkaya, 2009). In addition, it has been reported that a game-based learning approach might provide a good chance to stimulate children’s abstract thinking during the process of cognitive development, and further foster their higher order thinking ability (Carbonaro, Szafron, Cutumisu, & Schaeffer, 2010). Carroll (1982) stated that computer games are able to boost motivation owing to some characteristics, such as adventure, challenge and freshness. Therefore, if teachers are able to apply computer games to teaching, students can not only have better learning achievements, but also learn happily via these games.

Several previous studies have demonstrated the ease of use and usefulness features of computer games by applying the game-based learning approach to a variety of learning activities (Bourgonjon, Valcke, Soetaert, & Schellens, 2010; Warren, Dondlinger, & Barab, 2008). For example, Terrell and Rendulic (1996) stated that using computer games for learning in elementary schools can increase the internal motivations and learning achievements of students. Yun, Jiang and Li (2010) indicated that through computer games which focus on nutritional education in primary and secondary schools, the learning motivations and learning achievements of the students can be increased, and their competences and knowledge can be promoted. Papastergiou (2009b) also pointed out that through computer games, children’s learning interests are effectively promoted, and they are guided to actively improve their food and drink habits.

There are several theories that are recognized as being relevant to the game-based learning approach, such as cognitive theory and situated learning theory. Cognitive theory emphasizes that learners should master basic skills to further acquire higher-level abilities while learning new things. It also emphasizes that learning processes are progressive and move from simplicity to complexity; moreover, games that are adopted need to stimulate students’ learning motivation and make learning more fun (Gagné, 1985). Situated learning theory states that learners should enter learning scenarios to acquire knowledge. The knowledge that is actively explored in the scenarios should not only be useful, but should also be analogical. Therefore, establishing a rich learning scenario enables learners to gain practical problem-solving abilities via observation and behavioral exploration, and a well designed game is able to provide such a learning scenario (Winn, 1993; Young, 1993; Cuencalópez y Martín Cáceres, 2010; Kim, Park, & Baek, 2009). Some researchers believe that even the best teaching materials and techniques are not as good as having children learn happily via games (Norman, 1981). Compared with other media, games are closer to the children’s world and are easily accepted by them (Kafai, 1995). Furthermore, researchers believe that games can help children develop problem-solving skills (Seonju, 2002; Chuang & Chen, 2009; Lee & Chen, 2009; Blumberg, Rosenthal, & Randall, 2008; Shih, Shih, Shih, Su, & Chuang, 2010).

RESEARCH DESIGN
This study adopted a quasi-experimental nonequivalent-control group design. The independent variable was the
different teaching media. The experimental group received nutrition education with computer game-based teaching, while the control group was taught the nutrition content with a multimedia PowerPoint. The dependent variable, nutrition education, was included in the nutrition knowledge tests, the questionnaire of nutrition attitudes and the questionnaire of food- and- drink habits.

Participants
The participants in this study included sixty-six third graders in two classes of an elementary school in southern Taiwan. One of the classes was assigned to be the experimental group and the other was appointed to be the control group. In order to avoid influences caused by different instructors, the two classes were taught by the same instructor. Both the experimental group and the control group had thirty-three students, including eighteen males and fifteen females. This study lasted for four weeks, and each week included one nutrition education class.

Tools
To evaluate the learning achievements of the students, the nutrition knowledge test developed by Lo (2006) was adopted. The test consisted of twenty items, each of which was awarded one point if the students gave the correct answer. The Kuder-Richardson reliability of the test was 0.71, the item discrimination values were higher than 0.25, and the item difficulty values ranged from 0.4 to 0.8.

To measure the students’ learning attitudes toward the nutrition course, the questionnaire developed by Lin (2004) was adopted. It consisted of twenty items on a five-point Likert scale. The Cronbach’s $\alpha$ value of the questionnaire was 0.85, showing good reliability in internal consistency. In the meantime, another questionnaire developed by Her (2004) was adopted to evaluate the food- and- drink habits of the students. It consisted of twenty items on a five-point Likert scale. The Cronbach's $\alpha$ value of this questionnaire was 0.85, showing good reliability in internal consistency.

In addition, a survey consisting of twelve items on a five-point Likert scale was conducted to collect the feedback of the students regarding the game-based learning approach, including the aspects of ‘effects of computer games on nutrition knowledge,’ ‘effects of computer games on nutrition attitudes,’ ‘effects of computer games on food- and- drink habits’ and ‘viewpoints of computer game-based learning.’ This survey has been examined and revised by ten experts who are experienced in teaching nutrition courses. The Cronbach's $\alpha$ values of the four aspects and the entire questionnaire were .66 .61 .62 .72 and .82, respectively.

Learning Activities
Table 1 presents the teaching activities held in the study. The teaching activities were designed based on nutrition education to have four topics, including ‘Knowledge of eating functions,’ ‘Our eating,’ ‘Healthy eating habits’ and ‘Tracking eating habits.’ Each topic was taught for forty minutes. One class was held each week to fit in with the students’ physical education class. The experiment lasted for four weeks. The nutrition education for the two groups was the same, but the experimental group was taught via computer game-based instruction while the control group was instructed with multimedia PowerPoint.

<table>
<thead>
<tr>
<th>Class order</th>
<th>Topic</th>
<th>Purpose</th>
<th>Game title</th>
</tr>
</thead>
</table>
| First       | Knowledge of eating functions | 1. To experience the importance of food for psychological and physical needs  
2. To list reasons that influence personal food choices  
3. To classify the six types of food correctly | 1. Little Dietician  
2. Gifts from Heaven |
| Second      | Our eating | 1. To experience how environmental factors influence eating habits  
2. To speak of factors that influence eating habits | Saving Health Kingdom |
| Third       | Healthy eating habits | 1. To understand the disadvantages of eating fastfood often and be willing to reduce the amount of fastfood  
2. To choose nutritional meals for keeping fit | Health Superman’s Delicacy Island |
| Fourth      | Tracking eating habits | 1. To compare personal eating habits with standard healthy rules  
2. To practice good eating habits | Nutrition Supplement Battle |
There were five games used in this study, as shown in Figure 1 ‘Little Dietician,’ Figure 2 ‘Gifts from Heaven,’ Figure 3 ‘Saving Health Kingdom,’ Figure 4 ‘Health Superman’s Delicacy Island’ and Figure 5 ‘Nutrition Supplement Battle.’ The first two games mainly taught the students to correctly classify the six types of food for a balanced diet. The third game, Saving Health Kingdom, enabled the learners to understand that snacks, fast food and beverages are not essential elements of a diet, and their amount should be reduced. The fourth game, Health Superman’s Delicacy Island, instructed the students to combine different foods for a balanced diet via observation of a one-day diet. The last game, Nutrition Supplement Battle, made understandable that a lack of nutrients might lead to diseases by providing questions, hints and answers (Health e-learning network, 2010).
RESULTS

Learning Achievements

This study adopted the pretest scores of the nutrition knowledge test as the covariate for analysis of covariance (ANCOVA) to avoid the influence of the pretest on nutrition knowledge learning. One assumption of ANCOVA is that the regression coefficient of each regression line needs to be homogeneous. The interaction effect between the independent variable and the covariate of the nutrition knowledge test was not significant ($F=1.93$, $p>.05$), suggesting that the relationship between the covariate (the pre-test scores) and the dependent variable (the post-test scores) was not different by the levels of the independent variable. Therefore, further ANCOVA analysis was appropriate.

Table 2 shows the descriptive data and ANCOVA for the results of the nutrition knowledge posttest. The influence of the pretest scores on the nutrition knowledge test was excluded, and the learning achievements between the two groups were significantly different ($F =20.01$, $p < .001$). The adjusted mean of the experimental group was 17.39 while that of the control group was 14.64, implying that the learning achievement of the experimental group was significantly higher than that of the control group, showing that computer game-based instruction can effectively promote students’ nutrition knowledge.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>Adjusted Mean</th>
<th>Std. Error</th>
<th>$F$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-test</td>
<td>Experimental</td>
<td>33</td>
<td>16.94</td>
<td>2.38</td>
<td>17.39</td>
<td>.43</td>
<td>20.01***</td>
</tr>
<tr>
<td></td>
<td>Control group</td>
<td>33</td>
<td>15.09</td>
<td>3.39</td>
<td>14.64</td>
<td>.43</td>
<td></td>
</tr>
</tbody>
</table>

* $p<.001$
Learning Attitudes
The pretest scores of the questionnaire of nutrition attitudes were used as the covariate for ANCOVA. The interaction effect between the independent variable and the covariate of the questionnaire was not significant \((F=1.37, p=.25, p>.05)\), suggesting that the relationship between the covariate (the pre-test scores) and the dependent variable (the post-test scores) was not different by the levels of the independent variable; therefore, the ANCOVA could be further conducted.

As shown in Table 3, the learning achievements between the two groups were not significantly different \((F =.19, p=.66, p>.05)\) after the influence of the nutrition knowledge pretest scores were excluded. The adjusted mean for the experimental group was 88.98 whereas the adjusted mean for the control group was 88.36. The score of the experimental group was higher than that of the control group, but there was no significant difference between the two. Computer game-based instruction was not shown to enhance the nutrition attitudes of the students any more than multimedia PowerPoint instruction.

Table 3. ANCOVA result on the ratings of the attitudes toward the nutrition course

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>Adjusted Mean</th>
<th>Std.Error.</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-test</td>
<td>Experimental</td>
<td>33</td>
<td>88.82</td>
<td>7.28</td>
<td>88.98</td>
<td>1.00</td>
<td>.19</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>33</td>
<td>88.52</td>
<td>9.01</td>
<td>88.36</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

Food and Drink Habits
The pretest scores of the questionnaire of food and drink habits were used as the covariate for ANCOVA. The interaction effect between the independent variable and the covariate of the questionnaire was not significant \((F=1.59, p=.21, p>0.05)\). This suggests that the relationship between the covariate (pretest scores) and the dependent variable (posttest scores) was not different by the levels of the independent variable; therefore, the ANCOVA could be further conducted.

Table 4 shows the descriptive data and ANCOVA for the post-test results of the food and drink habit questionnaire. The influence of the pretest scores of the food and drink habit questionnaire was excluded, and the learning achievements between the two groups were significantly different \((F =4.17, p=.05, p<0.05)\). The adjusted mean of the experimental group was 89.28 whereas that of the control group was 86.05. The learning achievement of the experimental group was better than that of the control group, showing that computer game-based instruction can effectively enhance student food and drink habits.

Table 4. ANCOVA result on the ratings for the food and drink habit questionnaire

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>Adjusted Mean</th>
<th>Std.Error.</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-test</td>
<td>Experimental</td>
<td>33</td>
<td>88.46</td>
<td>10.36</td>
<td>89.28</td>
<td>1.12</td>
<td>4.17*</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>33</td>
<td>86.88</td>
<td>8.25</td>
<td>86.05</td>
<td>1.12</td>
<td></td>
</tr>
</tbody>
</table>

*\(p<.05\)

Learning Achievements between Genders
An analysis was made to further compare the nutrition knowledge, attitudes toward the nutrition course and food and drink habits between genders after participating in this learning activity. Table 5 shows the ANCOVA results on the posttest scores of the nutrition knowledge test and the post-questionnaire ratings for nutrition attitudes and food and drink habits between the two genders by excluding the influence of corresponding pre-test scores and pre-questionnaire ratings. It was found that there is no significant difference between genders in terms of the three aspects, implying that the game-based learning approach is helpful to both genders in improving their learning achievements and learning attitudes.

Table 5. ANCOVA results on the post-test results of different genders

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>Adjusted Mean</th>
<th>Std.Error.</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutrition knowledge test</td>
<td>male</td>
<td>17</td>
<td>17.47</td>
<td>2.00</td>
<td>17.29</td>
<td>.50</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>female</td>
<td>16</td>
<td>16.38</td>
<td>2.68</td>
<td>16.57</td>
<td>.51</td>
<td></td>
</tr>
<tr>
<td>Nutrition attitude questionnaire</td>
<td>male</td>
<td>17</td>
<td>89.65</td>
<td>6.62</td>
<td>88.81</td>
<td>1.44</td>
<td>.00</td>
</tr>
<tr>
<td></td>
<td>female</td>
<td>16</td>
<td>87.94</td>
<td>8.05</td>
<td>88.83</td>
<td>1.49</td>
<td></td>
</tr>
<tr>
<td>Food and drink habit questionnaire</td>
<td>male</td>
<td>17</td>
<td>87.29</td>
<td>11.96</td>
<td>87.97</td>
<td>1.86</td>
<td>.14</td>
</tr>
<tr>
<td></td>
<td>female</td>
<td>16</td>
<td>89.69</td>
<td>8.56</td>
<td>88.97</td>
<td>1.92</td>
<td></td>
</tr>
</tbody>
</table>
Feedback on the Game-based Learning Approach

Table 5 presents the survey of teaching viewpoints on computer game-based learning. In Part 1 ‘Influence of computer games on nutrition knowledge’, 1.1 ‘I can better understand which types of food are helpful for health’ scores the highest (4.97), while 1.2 ‘I am much clearer about different nutrients contained within different kinds of foods’ scores the lowest (4.79), showing that the students highly confirm the influence of computer games on nutrition knowledge learning.

In Part 2 ‘Influence of computer games on attitudes toward nutrition’, 2.3 ‘I want to learn more about how to choose helpful food for myself’ scores the highest (5.00), whereas 2.2 ‘I have become more careful in choosing food, scores the lowest (4.76), indicating that the students are positive toward the influence of computer games on nutrition attitudes.

In Part 3 ‘Influence of computer games on food and drink habits’, 3.1 ‘I will pay more attention to eating hygiene, has the highest score (4.91) and 3.3 ‘I am willing to share the nutrition knowledge with my family, has the lowest score (4.73). This reveals that the students hold positive views toward the influence of computer games on food and drink habits.

In Part 4 ‘Viewpoints on computer game-based learning’, 4.2 ‘I hope that other courses can also adopt computer game-based learning, scores higher (4.94), while 4.1 ‘I think that computer game-based learning is helpful to me, scores lower (4.73). This suggests that the students confirm the influence of computer games on their food and drink habits and hope to apply game-based learning to other subjects.

Table 6. Survey of the game-based learning approach

<table>
<thead>
<tr>
<th>Question</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Influence of computer games on nutrition knowledge</td>
<td>33</td>
<td>4.85</td>
<td>.22</td>
</tr>
<tr>
<td>1.1. I can better understand which types of food are helpful for health.</td>
<td>33</td>
<td>4.97</td>
<td>.17</td>
</tr>
<tr>
<td>1.2. I am much clearer about different nutrients contained within different kinds of foods.</td>
<td>33</td>
<td>4.79</td>
<td>.55</td>
</tr>
<tr>
<td>1.3. I am better able to understand that the lack of certain nutrients causes diseases.</td>
<td>33</td>
<td>4.82</td>
<td>.53</td>
</tr>
<tr>
<td>1.4. I can know more about the importance of food hygiene and food preservation methods.</td>
<td>33</td>
<td>4.82</td>
<td>.39</td>
</tr>
<tr>
<td>2. Influence of computer games on attitudes toward nutrition</td>
<td>33</td>
<td>4.89</td>
<td>.20</td>
</tr>
<tr>
<td>2.1. I will focus more on my eating habits and attitudes.</td>
<td>33</td>
<td>4.91</td>
<td>.38</td>
</tr>
<tr>
<td>2.2. I have become more careful in choosing food.</td>
<td>33</td>
<td>4.76</td>
<td>.50</td>
</tr>
<tr>
<td>2.3. I want to learn more about how to choose helpful food for myself.</td>
<td>33</td>
<td>5.00</td>
<td>.00</td>
</tr>
<tr>
<td>3. Influence of computer games on food and drink habits</td>
<td>33</td>
<td>4.84</td>
<td>.24</td>
</tr>
<tr>
<td>3.1. I will pay more attention to eating hygiene.</td>
<td>33</td>
<td>4.91</td>
<td>.29</td>
</tr>
<tr>
<td>3.2. I will further improve my incorrect eating habits.</td>
<td>33</td>
<td>4.88</td>
<td>.42</td>
</tr>
<tr>
<td>3.3. I am willing to share the nutrition knowledge with my family.</td>
<td>33</td>
<td>4.73</td>
<td>.63</td>
</tr>
<tr>
<td>4. Viewpoints on computer game-based learning</td>
<td>33</td>
<td>4.89</td>
<td>.15</td>
</tr>
<tr>
<td>4.1. I think that computer game-based learning is helpful to me.</td>
<td>33</td>
<td>4.73</td>
<td>.67</td>
</tr>
<tr>
<td>4.2. I hope that other courses can also adopt computer game-based learning.</td>
<td>33</td>
<td>4.94</td>
<td>.24</td>
</tr>
</tbody>
</table>

CONCLUSIONS

This study aims at investigating the learning achievements of the students in nutrition education via computer game-based learning and multimedia PowerPoint instruction. The experimental results reveal that computer game-based learning can improve the learning achievements and learning attitudes of students.

Moreover, it was found that the game-based learning approach is equally helpful to both male and female students in terms of nutrition knowledge, learning attitudes and food and drink habits. This finding is quite different from those of some previous studies that reported a difference between genders in using computers and networks (Dabaj, 2009; Pamuk & Peker, 2009; Imhof, Vollmeyer, & Beierlein, 2007; Delialioglu, Cakir, Bichelmeyer, Dennis, & Duffy, 2010).

Although the findings of this study are quite positive, longer experiments with larger samples need to be conducted in the future to further investigate the effectiveness of the game-based learning approach for nutrition education. It is expected that the innovative approach not only improves the students’ nutrition knowledge, but also fosters their food and drink habits in their daily lives.

In addition to the nutrition courses, this approach can be applied to other courses in the future. Moreover, as mobile and wireless communication technologies are becoming more popular, it has become an interesting and challenging issue to use mobile devices for conducting game-based learning activities in real-world learning
environments, so that the students can be situated in real-world scenarios with support or hints from the learning system (Chu, Hwang, Tsai, & Tseng, 2010; Hwang & Chang, 2011; Hwang, Tsai, & Yang, 2008; Hwang, Chu, Shih, Huang, & Tsai, 2010). The nutrition knowledge can be obtained from both real-world and digital-world contexts, which has been recognized by researchers as being a good way of shaping good habits (Chu, Hwang, & Tsai, 2010; Hwang, Shih, & Chu, 2010).

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A JOYFUL CLASSROOM LEARNING SYSTEM WITH ROBOT LEARNING COMPANION FOR CHILDREN TO LEARN MATHEMATICS MULTIPLICATION

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ABSTRACT
This research demonstrates the design of a Joyful Classroom Learning System (JCLS) with flexible, mobile and joyful features. The theoretical foundations of this research include the experiential learning theory, constructivist learning theory and joyful learning. The developed JCLS consists of the robot learning companion (RLC), sensing input device, mobile computation unit, mobile display device, wireless local network and operating software. The aim of this research is to design and evaluate the JCLS, which is implemented by using robot and RFID technologies. The developed JCLS system has been applied in real world for supporting children to learn mathematical multiplication. Both pilot experiment and formal experiment were conducted and the results showed that the JCLS can provide learners with more opportunities for hands-on exercises and deepening their impressions about the learning contents. Having many opportunities for hands-on exercises, learners can have more thinking time for knowledge construction. Using robot to design RLC can simultaneously increase learners’ motivations and offer a more joyful perception to learners during the learning process. On the other hand, the JCLS can support instructors to immediately acquire the learning statuses of every learner for adjusting his/her in-class instructional strategy and giving after-school assistances.

INTRODUCTION
Washburne (1936) defined learning as a process of acquiring knowledge, technique, attitude and value through instruction and experience. Human intelligence development is affected by the inborn conditions and acquired contexts since childhood. The development process contains several steps, and the time required for reaching each step is different for each individual learner because each previous step is the foundation for the next step and the sequence is successive (Flavell, 1963; Piaget, 1970). Therefore, a suitable learning environment with proper learning sequence is essential for learning, especially for children who are still in the early development period. Besides, researchers have also emphasized the importance of joyful learning for children in recent years (Fisher, 1998; Heywood, 2005). With nowadays newly invented technologies like educational robot and RFID make technology enhanced learning a promising solution for assisting children learners.

Theoretical foundations
The theoretical foundations of this research are the experiential learning theory, constructivist learning theory and joyful learning. The core concept of experiential learning theory (ELT) is that instructors should draw learners’ attention on their real-life experience while conducting experiential learning. Experiential learning follows four different steps including concrete experience, reflective observation, abstract conceptualization and active experimentation (Appelman, 2004; Kolb, 1984). It is a repeated cycle for the continuous experience and exploration (Kolb & Kolb, 2005). ELT also suggests that children would get a stronger impression about things if they could touch and manipulate tangible objects such as learning by doing. For example, learning by doing with sufficient practice time for learners was the predominant strategy as it is found to have positive effects for learning and knowledge construction (Appelman, 2004; Bruckman, 1998; Cronjé, 2006; Dewey, 1938; Kolb & Kolb, 2005; Piaget, 1968). Some practical examples are like BioHazard about environmental science (http://www.educationarcade.org/gtt/biohazard/Intro.htm), La Jungla de Optica about optical Physics (http://www.educationarcade.org/gtt/Jungle/Intro.htm), Daedalus’End about civil engineering and engineering ethics (http://www.educationarcade.org/gtt/Globalization/Intro.htm), and Quest Atlantis about language arts, mathematics, and social studies in a multi-user 3-D virtual environment (Barab, Thomas, Dodge, Carteaux, &
Equal opportunities provided to learners for engaging learning activities in a learning environment are also necessary and important (Cheng, Wu, Liao, & Chan, 2009). Acquiring stronger impressions through the hands-on experiences have a great potential to contribute in knowledge construction and comprehensions. As suggested by constructivist learning theory (CLT) that knowledge cannot be directly supplied by instructors or others, but has to be created by learners themselves (Bruckman, 1998; Cronjé, 2006; Piaget, 1968). Some practical examples are like the players learn through iterative design processes, observing how the robot works, and modifying the robot design (http://www.educationarcade.org/gtt/hephaestus/Intro.htm). Instructors play the role of an organizer, facilitator and resource provider to help learners in their learning process. Learners can concentrate on acquiring knowledge, skills and values through repeated self-thinking exercises in a well-designed learning environment based on ELT and CLT (Dewey, 1938).

Joy, according to the Oxford English dictionary, is described as a vivid emotion/feeling of pleasure. The adjective of joy is joyful which also describes a kind of feeling, expressing and causes great pleasure. In this research, we define the “joyful learning” as a kind of learning process or experience which could make learners feel pleasure in a learning scenario/process. A joyful perception is found to have positive influence on the motivation of learning (Chen, Chen, & Liu, 2010; Kirikkaya, İşeri, & Vurkaya, 2010). A number of modern educational games with joyful learning features are being developed by various researchers based on pedagogical theories and strategies (Chen & Tsai, 2009; Kebritchi & Hirumi, 2008).

Instruction and learning perspectives
The two main perspectives, namely learning and instruction, are included in this research. From the learning perspective, learners’ problem solving abilities are very important and could be cultivated through adopting appropriate pedagogies in learning processes. How to cultivate problem solving ability is very critical during childhood while a learner is beginning to learn and receive instruction. Therefore, from the learning perspective while designing the JCLS, the goal is to train and cultivate learners’ problem solving abilities (Lindh & Holgersson, 2007; Tsai, Chen, & Chen, 2010).

From the instruction perspective, if instructors simply use oral lectures to explain learning materials, sometime learners are not able to comprehend the meaning. In such a situation, instructors can use physical objects or tangible tools for providing learning help. For example, instructors could utilize physical learning materials to enhance learners’ realization about learning contents. However, the problem is that how could an instructor acquire the real-time progress status of each individual learner so as to provide instant help. This is particular difficult in conventional learning environments without any information and communication technology (ICT) support. The ICT advancements have made technology enhanced learning (Chen, Lin, & Kinshuk, 2008; Schiaffino, Garcia, & Amandi, 2008) and mobile learning (Huang, Kuo, Lin, & Cheng, 2008; Motiwalla, 2007) more and more popular in our educational settings.

Robot-related applications in educational field
Due to the rapid developments of new technologies, educational researchers can now apply various ICT tools in practical scenarios to enhance learning experiences and performances of learners such as multimedia, interactive white board, smartphone, and robot. In February 2010, Ministry of Education in South Korea announced that they will equip robots for all 8,400 domestic kindergartens to facilitate instruction by 2013. Educational researchers evidence that the robot as an instructional assistant or a learning companion can enhance learners’ learning motivation and learning performance (Barker & Ansorge, 2007; Chen, Hung, Lee, & Wei, 2010; Chung, et al., 2010; Fasola & Mataric, 2010; Johnson, 2003; Klassner & Anderson, 2003; Mitnik, Recabarren, Nussbaum, & Soto, 2009; Ruiz-del-Solar & Aviles, 2004). Furthermore, using robot as an instructional assistant or a learning companion, can also enable instructors to provide learning content which facilitating learners to interact with real objects through navigating digital learning content (Jermann, Soller, & Mühlenbrock, 2001). For example, while learners are learning physics, the robot can utilize its capabilities, including rotation, mobility, and acceleration, to explain the Newton’s laws of motion (Mitnik, Nussbaum, & Soto, 2008).

In the near future, school-age children are predicted to have educational robots accompanying them in the learning process and assisting them in comprehending the learning materials (Jones, Jo, & Han, 2006). Before discussing robot applications in educational field, it would be important to analyze the types of robots in general. This research categorizes robots into three types according to the purpose of their original design, namely (a) pure toy, (b) education and recreation, and (c) purpose on-demand robot. The comparisons of these three types of robots are described in Table 1.
The first type pure toy is a generic robot that is commonly treated as simply playing for fun. This type of robots is originally designed for entertainment, and therefore they do not have many complex functions or reconfigurable capabilities. But, it is possible to use them in a conventional physical classroom for assisting instruction by designing suitable learning activities, for example, Wowwee’s Spain series (You, Shen, Chang, Liu, & Chen, 2006) and Sony’s AIBO robot dog (Francis & Mishra, 2009). The second type of robots is designed dedicated for education and recreation such as the widely known LEGO MINDSTORMS series. Various schools nowadays are using this type of robots for training and stimulating logical thinking abilities of pupils through assembling the robots with LEGO bricks and programming them in the visual programming systems (VPS), for examples LEGO’s ROBOLAB software or some other third-party products (Jarvinen, 1998; Lindh & Holgersson, 2007). Some researchers have focused on designing agent-based systems to assist instructors in monitoring learners’ learning status by using robots (Zhang, Kinshuk, Jormannainen, & Sutinen, 2008). The third type of robots, purpose on demand (POD), is designed for specific research, industrial use or other particular purposes. Their powerful hardware, complex functions, and flexible configurations make them very useful for advanced applications.

**Research objectives and questions**

The aim of this research is to design and evaluate a JCLS by using RLC and RFID technologies. The designed system can be used in three different learning scenarios including conventional physical classroom teaching, classroom group collaborative learning and self-paced learning at home by supporting three application modes, namely instruction, collaborative learning and self-learning.

A prototype has been designed for a Joyful Classroom Learning System (JCLS) in this research to support children’s learning in mathematics. The JCLS is designed and implemented using robot learning companion (RLC) and Radio-Frequency IDentification (RFID) technologies. The RLC has a tangible body with several intellectual actions that are useful in a learning process and could bring joyful perceptions to the learners. The RFID technologies could help learners to simplified data input especially for little children who are not familiar with QWERTY keyboard.

After designed and implemented the Joyful Classroom Learning System (JCLS), the evaluation of the system was conducted with respect to the two questions. (a) Can the designed JCLS help children learners to have better learning experiences in terms of experiential learning, constructivist learning and joyful learning? (b) How do children learners perceive the usefulness and ease of use of the JCLS?
Design and Implementation of a Joyful Classroom Learning System (JCLS)

**Key hardware components**
Robot learning companion, sensing input devices, mobile computation unit, mobile display devices and wireless local network construct the whole hardware components of the designed JCLS. These five components are essentially required for designing different learning scenarios in the JCLS. To choose suitable devices for these five components depend on the designed learning activities and available products in the market. A survey has been done on commonly used products and their main functions which can be used for these five components as shown in Table 2.

The RLC can attract learners’ attentions resulting in improved motivation for learning. In this research, the LEGO MINDSTORMS NXT is adopted to be the robot learning companion and mobile display device. The RFID is used as the sensing input device. The mobility of the computation unit is crucial as it enables children learners to move around the classroom while doing group collaborative learning. The designed JCLS currently adopts Wi-Fi to build a wireless local network for information exchange among interconnected devices. Of course, other wireless local network technologies such as ZigBee (Morais, et al., 2008) and GroupNet (Chen, Kinshuk, Wei, & Yang, 2008) can also be used as a solution if they become cheaper and more popular.

<table>
<thead>
<tr>
<th>Element</th>
<th>Example</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robot learning companion</td>
<td>LEGO MINDSTORMS NXT*, Wowwee Robosapien, and Aldebaran Robotics Nao</td>
<td>Interaction</td>
</tr>
<tr>
<td>Sensing input device</td>
<td>Barcode, RFID*, QR Code, Electronic pen, and Laser projector keyboard</td>
<td>Input</td>
</tr>
<tr>
<td>Mobile computation unit</td>
<td>Laptop*, OLPC, Netbook, PDA, Smartphone, iPhone and iPad</td>
<td>Processing and storage</td>
</tr>
<tr>
<td>Mobile display device</td>
<td>Embedded display in the RLC*, Portable projector, Touch screen, Electronic paper, and Eye screen</td>
<td>Output</td>
</tr>
<tr>
<td>Wireless local network</td>
<td>Bluetooth, Wi-Fi*, ZigBee, and GroupNet</td>
<td>Data exchange</td>
</tr>
</tbody>
</table>

*Note: * represents the option used in this research

**Application modes**
Three application modes were designed for the JCLS. The first mode is called instruction mode (Figure 1(a)). Every learner is provided with a RLC that enables all learners to have an “equal opportunity” to participate in the classroom learning activities guided by the instructor. Every learner in the JCLS can directly interact with his/her RLC for a better engagement in the learning process, compared to the traditional sit-and-listen leaning environment. An instructor can use the instruction mode to quickly deploy learning materials to learners in the class. In the meantime, the system will be automatically logging and sorting the learning status of every learner throughout the learning activity. This feature enables an instructor to view the summary of important information about learners making it possible for the instructor to provide timely assistance to the learners. Furthermore, since the JCLS has recorded complete logs of every learner, a deeper analysis of the learning patterns for each individual learner is also possible, making it easier for an instructor to better understand the obstacles experienced by any individual learner during the learning process. Based on such analysis, the instructor has the possibility to provide adaptive instruction to each individual learner.

The second mode is called collaborative learning mode (Figure 1(b)). The JCLS provides a grouping mechanism to support collaborative learning. Learners can be grouped into several teams for carrying out collaborative learning activities. The features of flexibility, mobility, and joyfulness can be included for collaborative learning activities in the JCLS, for achieving more positive effects in the learning process. Once learning activities are being designed, the JCLS can act accordingly to guide learners going through the collaborative learning process without instructor’s intervention. That is to say instructors play the role of facilitators whereby an unforeseen situations occurs, they can then provide appropriate assistance if necessary. The JCLS keeps the instructors with updated information about each team’s progress in order to ensure that the goals of the learning activities are finally achieved.
The third mode is called self-learning mode (Figure 1(c)). This mode provides a useful and friendly way for a learner to preview or review learning contents. The functionality of the JCLS in this mode is much simpler, and it only focuses on providing suitable learning content to the learner based on the built-in learning materials database, making the learning process more effective for the individual learners. Learners however, also have the opportunities to request the learning content according to their own preferences. The role of RLC here acts like an accompanying tutor who could give a learner timely feedback and guidance making self-learning less feeling of learning alone.

The implementation of joyful classroom learning system (JCLS)

As shown in Figure 2(a), the JCLS furnishes every learner with a “learning station” comprising of robot learning companion (RLC), sensing input device, mobile computation unit, mobile display device, wireless local network and the operating software. In practice, the learning station consists of a LEGO MINDSTORMS NXT, a laptop, an RFID reader, learning materials with RFID tags, and operating software for learners. Regardless of which application mode the learners are currently in, they interact directly with the RLC while engaging in learning activities by using a more intuitive method of RFID tags as inputs rather than a traditional keyboard typing. On the other hand, the instructor has a control station comprising of mobile computation unit, mobile display device, wireless local network, and the operating software.

The architecture of the JCLS can be subdivided into two parts, hardware and software. In a typical scenario for the instruction mode, the control station and all learning stations are interconnected through Wi-Fi network connection as shown in Figure 2(b). RLCs and RFID readers are connected to learners’ learning stations. The RFID tags are attached to the physical learning materials and given to the learners. The information of the learning material stored in RFID tags is retrieved by the RFID reader. Depending on what information is received through RFID tags, the system then triggers RLCs to make some actions, show some brief information on their screens, and utter corresponding sound as feedback to learners. The JCLS operating software equips with two agents, namely control agent and coordination agent, and five modules, namely notification, sound effect, motion, instruction and presentation. Coordination agent is in charge of the initiation of these five modules depending on the application mode and for starting the networking in order to facilitate information exchange. Next, the control agent takes over the follow-up operations for the activated modules.

The logical flow of the instructional mode is shown in Figure 3. In the beginning, the coordination agent senses that the instruction mode has been activated and starts the networking for information exchange. Next, it initiates all the five modules and informs the control agent to take over the follow-up operations. The JCLS runs on both the control station (Figure 4(a)) and the learning station (Figure 4(b)). Instruction, notification and presentation modules are then enabled at the control station which used by the instructor. All learning stations remains under the instructor’s control in order to provide the learner with related learning materials and guidance during the learning process. Various learning activities can be accomplished by interacting with the RLCs and using RFID tags. Furthermore, notification module is enabled at the control station in order for the instructor to monitor all
actions taken by learners at all learning stations. The control station provides three main functions for instruction. Firstly, it handles the switching of the application mode in order to enable correct mode to align with the current learning scenario. Secondly, delivery of the learning materials to learners is handled by instruction module of control station (e.g., the questions asked by the instructor and the answers given by the learners). Finally, the presentation module displays the summarized information from the notification module at the control station, such as the brief statistical results, pie chart and other visual presentation for the instructor to aware all learners’ situations in a real time manner.

Figure 2: (a) Sketch map of the JCLS; (b) A typical instruction mode connections of the JCLS

Figure 3: The flow chart for instruction mode of the JCLS
METHODOLOGY

Participants
To evaluate the developed system, this research conducted two experiments, namely pilot experiment (Chen, Hung, & Wei, 2010) and formal experiment. The pilot experiment helped improve formal experiment more completely and the all participants of it were different from the formal experiment. The formal experiment, including an experimental group and a control group, was conducted with 47 elementary school students in grade two. As shown in Figure 5(a), the experimental group, composed of 24 students including 9 boys and 15 girls, was arranged to learn with the JCLS. The control group as shown in Figure 5(b), composed of 23 students including 10 boys and 13 girls, was arranged to learn with traditional learning method by using the blackboard.

In order to maintain better quality for observation during the learning process, the maximum number of participants in the experimental group is limited to six students in each round. The experimental group therefore divided into four rounds. The participants of experimental group and control group were from two different classes. The observation method, questionnaires, and interviews were adopted for data collection in this research.

Experimental Procedures
The experimental procedures comprise the experimental group and the control group respectively. For the experimental group procedure, there were seven steps as shown in Figure 6(a).

Step 1: Set up the environment and introduce the goal of this formal experiment. The instructor gave physical learning materials with 11 RFID tags containing ten numbers (0 to 9) and two command symbols (enter and clear). Control station had pre-prepared item-bank database about learning multiplication and every learner was provided with a learning station.

Step 2: Instruction on how to use the JCLS. The instructor gave an introduction in five minutes to the learners about how to use the JCLS. Learners use a hammer shape RFID reader to touch a desired RFID tag (representing the number among 0-9) while they were trying to answer a multiplication question/exercise.

Step 3: Instruction on principles of multiplication. The instructor then provided the instructions about the topic of multiplication. All available instructional strategies could be used for instruction. For example, Learning by doing by giving enough time for learners to practice was the predominant strategy as it is found to be more effective for learning and knowledge construction (Appelman, 2004; Bruckman, 1998; Cronjé, 2006; Dewey, 1938; Kolb & Kolb, 2005; Piaget, 1968).

Step 4: Exercise practices with the JCLS. The instructor gave several questions related to the topics
which were taught in the previous step. Learners used RFID tags to input their answers or calculation process, if they cannot get the correct answers, they are free to try for several times, and the RLC will spontaneously react to learners with proper actions or sounds based on the inputs (Figure 7). In such kind of design, every learner in the JCLS’s learning environment has a “fair opportunity” to be engaged in the hands-on practice. The JCLS actively but silently logged all learning activities of each learner in the background at the same time.

Step 5: The instructor choose the best question for the next exercise based on the feedback of the whole learners of the experimental group. The instructor was able to timely receive the summarized information about learners such as the accuracy of answering questions. Furthermore, the instructor can use more detail information in the learning activity logs of an individual learner for analyzing learning obstacles and provide customized assistance to the specific learner. The steps of Step 4 and Step 5 usually repeated a couple of times until most learners had achieved the designated learning goal.

Step 6: Fill the questionnaire. Once the instructor finished the instruction process and verified that the learners had achieved the learning outcomes, the instructor ended the learning activity. All learners were then asked to fill the questionnaire designed for evaluating the extent of the three main constructs of this research, including experiential learning, constructivist learning, and joyful learning.

Step 7: One-to-one interview. The interview focused on the understanding of learners’ perceptions about using the JCLS. Each interview was approximately 10 minutes in duration. The interview questions were about how the learner’s perceived differently between learners in the experimental group and in the control group.

For the control group procedure, there were five steps as shown in Figure 6(b). Step 1 and step 2 were identical as the experimental group except for setting up the environment.

Step 3: Exercise practices with traditional blackboard. The instructor gave questions related to the topics just taught in the previous step to only a few students and asked them to answer by using the blackboard. Due to the space limitation of the blackboard, it is not possible for every learner to have a fair opportunity to do hands-on practice.

Step 4: Instructor gave a question for the next exercise based on the feedback of those few students who had practiced on the blackboard. As the instructor cannot get the whole picture of all students’ learning status, the adjustment of instructional strategies can only rely on the instructor’s subjective experience. The processes of Step 3 and 4 could also repeat a couple of times which was decided by the instructor.

Step 5: Fill the questionnaire. While instructor completed the instruction, the learning activity was ended as well. All learners were asked to fill the questionnaire.

Figure 6: Experimental procedures: (a) Experimental group (b) Control group

Figure 7: Learners can practice several times with the JCLS
Data collection

The collected data of the formal experiment includes four different parts, namely pre-test, questionnaire, observation and interview. Firstly, the pre-test were used to test if the participants in the experimental group and the control group have the same level of mathematic performance before the formal experiment. There were three basic multiplication questions used for the pre-test. Secondly, a questionnaire was given to all participants for acquiring their feedback and perceptions. Thirdly, observation data were recorded during the whole learning activity in the formal experiment. Finally, interview was used to obtain the deeper understanding of the learners in experimental group. All collected data were analyzed for findings using triangulation validation method (Armstrong, Gosling, Weinman, & Marteau, 1997).

The questionnaire includes three different parts which is corresponding to the three constructs of experiential learning, constructivist learning and joyful learning respectively. Each construct has four items in the questionnaire and adopts ten-point Likert scale. The reasons why using ten-point Likert scale are as follows: (a) the ten-point Likert scale for children is easier to understand compared to other kinds (Van Laerhoven, van der Zaag-Loonen, & Derkx, 2004); (b) the option like neither agree nor disagree is not available because the neutral option for assessing the perception of each item is not suitable, so the forced choice method (Dunnette, McCartney, Carlson, & Kirchner, 1962) was adopted in this research; and (c) the markings in Taiwan usually use centesimal grading and the children learners also expressed that using scores from 1 to 10 are more understandable in the pilot experiment (Chen, Hung, & Wei, 2010).

At the end of the formal experiment, forty-three valid questionnaires were collected including twenty-two from the experimental group and twenty-one from the control group after eliminating three invalid samples (i.e., outliers or missing data). The sampling accuracy assessed by the Kaiser-Meyer-Olkin (KMO) is .769 which is better than the recommended value of .60 (Kaiser, 1974). After that, the factor analysis was used to examine the convergent validity between items in the same construct and the discriminant validity between items among different constructs. The principal component method of factor analysis was used with Varimax (orthogonal) rotation. The JL2 item was removed because items that do not load together may be removed from the questionnaire (Churchill, 1979). The EL3 item was also removed because it is recommended that no item cross-loadings should be above .40 (Hair, Anderson, Tatham, & Black, 1998). The factor loadings of the CL1 item is lower than the minimum factor loading .60 on its hypothesized constructs proposed (Nually, 1978), so CL1 was also removed. The result of factor analysis after removing these three items is listed in Table 3.

Table 3: Rotated component matrix after removing three items

<table>
<thead>
<tr>
<th>Component</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>JL 1</td>
<td>.857</td>
<td></td>
<td></td>
</tr>
<tr>
<td>JL 3</td>
<td>.877</td>
<td></td>
<td></td>
</tr>
<tr>
<td>JL 4</td>
<td>.867</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EL 1</td>
<td></td>
<td>.869</td>
<td></td>
</tr>
<tr>
<td>EL 2</td>
<td></td>
<td>.767</td>
<td></td>
</tr>
<tr>
<td>EL 4</td>
<td></td>
<td>.754</td>
<td></td>
</tr>
<tr>
<td>CL 2</td>
<td></td>
<td></td>
<td>.867</td>
</tr>
<tr>
<td>CL 3</td>
<td></td>
<td></td>
<td>.754</td>
</tr>
<tr>
<td>CL 4</td>
<td></td>
<td></td>
<td>.634</td>
</tr>
</tbody>
</table>

According to Table 3, three components were labeled as joyful learning (JL), experiential learning (EL), and constructivist learning (CL) respectively. Internal consistency was evaluated using Cronbach’s alpha. The Cronbach’s alpha reliability coefficients were all higher than the minimum cutoff value of .70 (Table 4) and hence good for the follow-up analysis (Hair, et al., 1998; Nunnally & Bernstein, 1994).

Table 4: Reliability analysis results

<table>
<thead>
<tr>
<th>Construct</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiential Learning</td>
<td>.809</td>
</tr>
<tr>
<td>Constructivist Learning</td>
<td>.765</td>
</tr>
<tr>
<td>Joyful Learning</td>
<td>.926</td>
</tr>
</tbody>
</table>

The observation form designed in this research comprises several observable indicators, namely perception about instruction, the problem solving process, the facial expression, the gesture, and the learning atmosphere. The observable indicators are designed according to the three nexus concepts of the experiential learning, the constructivist learning and the joyful learning. The first part is to observe whether the learners are actively
engaged in answering the questions given by instructor. The second part is to observe whether the learners will do several tries to figure out the correct answer while the robot learning companion (RLC) tells them the answer was wrong. The third part is to observe whether the learners would feel joyful perceptions while the RLC tells them with cheerful messages like “You are right” or “Good job”. The last part is to observe whether the overall learning atmosphere was hedonic.

The operations of the interview focused on digging more detail information about how the learners used the JCLS to perform learning activities. Six interviewees participated in this one-to-one interview. Each interviewee spent approximately 10 minutes on completing the whole interview process. The open-structure questions of this interview were about the different perceptions of the learners between using the JCLS and the traditional learning method in learning mathematics.

RESULTS
The first test was performed to confirm whether the experimental group and the control group learners were having the same level of multiplication knowledge by analyzing the data collected from the pre-test. The results show that both experimental group and control group learners got the same mean score for the pre-test, which implies their initial points were the same.

Secondly, the data collected from the questionnaire was evaluated by independent t-test analysis and the result is shown in Table 5. A significant difference (p < .000) between the experimental group and control group was also found for the experimental learning construct. For the constructivist learning construct, there was a significant difference (p < .000) between the experimental group and control group. For the joyful learning construct, there was also a significant difference between these two groups despite the p-value is equal to .043 which is close to the significant boundary.

<table>
<thead>
<tr>
<th>Construct</th>
<th>CG</th>
<th>EG</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructivist Learning</td>
<td>CG</td>
<td>EG</td>
<td>-5.988</td>
<td>32.964</td>
<td>.000</td>
<td>-2.46825</td>
</tr>
<tr>
<td>Experiential Learning</td>
<td>CG</td>
<td>EG</td>
<td>-6.958</td>
<td>21.851</td>
<td>.000</td>
<td>-3.26768</td>
</tr>
<tr>
<td>Joyful Learning</td>
<td>CG</td>
<td>EG</td>
<td>-2.156</td>
<td>20.567</td>
<td>.043</td>
<td>-.864</td>
</tr>
</tbody>
</table>

Note: * p<.05; ** p<.01; *** p<.001;  
CG - Control Group; EG - Experimental Group

Thirdly, the analyzed results from the observation are shown in Table 6. Both observable indicators of learners do the hands-on practice actively, and several tries to figure out the correct answer show very high percentage (94.45%). Furthermore, 90.91% of learners would feel very happy when got praise from the RLC, and the overall learning atmosphere is very hedonic.

<table>
<thead>
<tr>
<th>Observable Indicator</th>
<th>N</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learners do the hands-on practice actively</td>
<td>21</td>
<td>95.45%</td>
</tr>
<tr>
<td>Learners do several tries to figure out the correct answer</td>
<td>21</td>
<td>95.45%</td>
</tr>
<tr>
<td>Learners feel happy (having joyful perceptions) e.g., smiles</td>
<td>20</td>
<td>90.91%</td>
</tr>
<tr>
<td>Overall learning atmosphere is hedonic</td>
<td>22</td>
<td>100%</td>
</tr>
</tbody>
</table>

Note: The total valid number of all learners in experimental group is 22.

Finally, the results from the interviews can be summarized as follows: (a) most learners agreed that using blackboard for exercises were to limited, however using the JCLS with RLC really enhanced their learning motivations; (b) Many learners also acknowledged that learning with RLC was much interesting than learning in a traditional classroom; and (c) some learners expressed that the opportunity of making several tries to figure out the correct answer was very useful for them to figure out why the mistakes they had made.

DISCUSSIONS
With the results stated above, some discussions and implications can be further elaborated by using data triangulation. Firstly, for the experiential learning, the “learning by doing” strategy was adopted in experimental learning. Learners learned multiplication of mathematics through hands-on practices including using quantities
of tangible objects in reality or drawing numbers of intangible objects on the blank paper for calculation. The questionnaire results found that the learners in the experimental group had deeper impression about the teaching mathematics content through hands-on exercises by using the JCLS. However, in control group, there are only about a few learners had the chance to use blackboard for hands-on practices, and some of these learners may be uncomfortable as they were forced to practice in front of all other learners. In the interview, one learner said that he did not like being forced to solve problems with blackboard, and if the RLC could tell him right or wrong, he will be glad to practice these exercise on his own. Therefore, the JCLS did allow every learner to have the “fair opportunity” of doing each hands-on practice which in turn deepened their impressions about the learning contents.

Secondly, for the constructivist learning, learners can have several chances to revise their answer for a question by the feedback of peers and instructions/assistance of the instructor. Through this kind of repeating process, learners can unceasingly refine their concepts of multiplication calculation and finally obtain the correct knowledge of multiplication calculation. There were two major differences between the experimental group and the control group. One was the learning feedback responsiveness and the other one was hands-on exercises opportunity. In traditional classroom teaching environments, instructors can only base on their subjective teaching experiences to adjust their instructional strategies for guiding learners to think. If instructors want to adjust their instructional strategies based on the feedback of every learner during the class, it would be very time-consuming and less efficient. However, instructors can easily see every learner’s learning status in the JCLS and immediately adjust their instructional strategies based on the timely feedback during the class. On the other hand, all learners can try to do exercises at the same time for several times with the support of the JCLS. This kind of re-try process is very useful for constructing one’s own mathematics knowledge.

Thirdly, for the joyful learning, it was found that joyful learning had positive influences on learning motivations from the observation and interviews. Many learners were observed that they showed a high degree of interest in interacting with the robot learning companion. For example, there were two learners waved their hands to the RLCs (Figure 8(a)) which implies learners truly thought RLC as their learning companion (i.e., partner). And many learners also have dense interests about the RLC (Figure 8(b)). Some learners expressed during the interview that the classes of the experiment group and control group were more interesting than their ordinary mathematics classes, and the classes with the JCLS were the most interesting. When learners have higher interests and joyful perceptions during the learning process, their learning motivations will be higher and their learning outcomes will be better.

Finally, in the pilot experiment, two parents expressed their concern about using RFID tags for simple numeric answer input might take too much time than directly writing down on the paper in the class. In other words, the two parents were worried about the complexity of operating the ICT devices. Two independent constructs of TAM (Davis, 1989), namely perceived usefulness (PU) and perceived ease of use (PEOU) were adopted. The main purpose focused on understanding how the learners felt the JCLS on usefulness and ease of use. So in the formal experiment, the data of the perceived usefulness and the perceived ease of use based on the TAM questionnaire were collected to confirm the acceptance of the JCLS for children’s mathematics learning. The results (Table 7) show that the scores of both perceived usefulness and perceived ease of use were very high which very close to the maximum value of the scale. According to the result of analysis, the concern issue from two parents of participants in the pilot experiment can be regarded which was not truly happened.

<table>
<thead>
<tr>
<th>Table 7: Result on usefulness and ease of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Perceived Usefulness (PU)</td>
</tr>
<tr>
<td>Perceived Ease of Use (PEOU)</td>
</tr>
</tbody>
</table>
CONCLUSIONS
The aim of this research is to design and evaluate a JCLS for supporting children’s learning by using RLC and RFID technologies. The results show that the JCLS can help children learners to have better learning experiences in terms of experiential learning, constructivist learning and joyful learning. Many learners responded that JCLS could increase their learning motivations and help them concentrate on the instruction and learning activity. Results also found that children learners were well-perceived the usefulness and ease of use of the JCLS. The main contribution of this research is to show the feasibility and potential of applying educational robots and RFID technologies to help children learners to do mathematical learning.

There are two limitations in this research. Firstly, this research did not investigate the learning performance because this research was focused on the design and implementation of the JCLS to support children’s learning. Future research should consider conducting a long-term experiment to investigate the effects of learning performance and the differences across various grade levels. The second limitation is the learning contents designed in this research was not suitable for adaptive learning. How to design adaptive learning contents driven by robot learning companion would be a very promising future research topic.

ACKNOWLEDGEMENTS
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A SMALL SCALE EXPERIMENTAL STUDY: USING ANIMATIONS TO LEARN VOCABULARY

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ABSTRACT
This study attempts to investigate whether a difference exists between learning vocabulary via animation and via traditional paper-based method. This small scale study was conducted at Karadeniz Technical University in academic year 2009-2010. Two pre-intermediate classes were randomly selected as the experimental group (n=17), and control group (n=22) as each class accommodated that number. Results obtained from the data gathered with a pre-test and a post-test applied to each group was analyzed using t-test in SPSS 16.00 version. The findings show that although there is no statistically significant difference between post-tests of each group, there was an increase in the post-test scores of animation group as compared to the pre-test scores. This increase implies that using multimedia such as animations contribute to students’ achievement in vocabulary learning. Besides, the teachers’ observations and students’ opinions indicate that there were relatively positive attitudes towards using such kind of animations in vocabulary learning. They were useful since they address more senses than using paper-based texts; however, they can be distractive if teachers do not pay attention to the proficiency level of students and the content presented. The study supports the idea that multimedia applications can be integrated into language classes not as an alternative way but as an additional way to contribute positively to the atmosphere of class and motivation of students.

Keywords: CALL, animation, vocabulary learning, multimedia.

INTRODUCTION
One of the biggest symbols of our modern age is the computer. Computers are almost everywhere. It is not wrong to say that the world has totally digitalized. Education has definitely been effected by the digital world. The fast moving technology provides people in the area of education with limitless opportunities. With the global interest in computers, innovative teaching methods have been oriented to foreign language learning environments. These teaching methods present different functions for educational environments. Computers have potential advantages to both the teachers and the student. Animation, though one small part of the computer revolution is very important part of high technology.

Vocabulary learning constitutes a basic and an important part of foreign language learning. Without vocabulary building, it is difficult to study grammar, speaking, listening, writing etc. However, it is not an easy task to memorize a large amount of vocabulary. It is relatively difficult to learn new words, to keep words in mind and to recall them when needed. With the help of innovative methods and materials that multimedia provides, language learning environments can be more colourful, motivating and at the same time more supportive for students in the learning process. It seems difficult to learn a new language with such a bulk of words just by looking up a word or a term in dictionaries. Therefore, introducing words using a new method is necessary. This new method uses an animation to present the words. As a tool, an animation makes students more focused on the words because it is interactive and addresses almost all senses as well. While they try to understand the meaning of words associating the scenes that they watch on the screen, they are also exposed to the pronunciation of words and the written form of words simultaneously. It is thought that vocabulary will be interesting and exciting activity for the students in the language learning process. To learn words in a context but with animation is thought to make learning process much easier for students.

Today, one of the most serious problems in Turkey is foreign language learning. To teach students in large diverse classrooms is not easy and students have little chance to get first-hand knowledge through conversations with natives. For such a problem, learning with computers can be one of the effective ways to help students in
the learning process. With the rapid increase in computers at schools in Turkey in recent years, students now have more chance to learn foreign language in CALL-based environments.

In this respect, this study aims to find out whether CALL-based vocabulary learning better facilitates vocabulary learning when compared to the traditional method. This does not intend to find a favored medium for vocabulary learning but just to see if there any difference exists between two different environments in our case.

**Computer Assisted Language Learning (CALL)**

Computer assisted language learning (CALL) dates back to 1960. After the invention of personal computers (PC) towards the end of 1970s, CALL gained ground and broadened its field in the 1980s (Davies, 2002). It is briefly defined as “the search for and study of applications of the computer in language teaching and learning” (Levy, 1997:1). In time, applications of computers have changed to meet the needs of both students and teachers in language classrooms. Indicating this change in educational environments, Warschauer (2004, p. 21-22) clarifies:

> There has been a general transformation in CALL over the years, with new ideas and uses of computers being introduced. The first phase of CALL development was Structural CALL, an approach used during the1960s and 1970s that followed the teaching techniques of structural linguistics. Here CALL primarily took the form of drill and practice programs. However, by the end of the 1970s, such behavioristic approaches to language learning had given way to communicative approaches focusing on the meaning of language in use rather than on its form, and this was reflected the changed nature of CALL activities.

This permanent use of CALL shows that there are endless uses and functions that CALL can serve in language classrooms although the approaches and activities may differ in time. Thanks to CALL, teachers have more to offer students in the process of language learning. After uses of devices such as “tape recorders, slide projectors, overhead projectors and videotape recorders”; teachers now have even more opportunities to introduce language skills in more than one form. (Price, 1987: 155). Rather than the traditional method of teaching, computers combine the features of projectors, tape-recorders and lecturing. This means that students can process knowledge of language through different channels simultaneously, which is the outcome of CALL.

There is also general tendency towards a changeover from books to computers since computers are regarded as more powerful and have wider knowledge than books. In accordance with this idea, Harmer (200, p. 146) points out the foremost use of computers and he defines them as “a reference tool”. Instead of searching from books or dictionaries, teachers and students can make great use of CD/DVD-ROMS and internet via computers for gaining knowledge and improving their language skills. In addition, CALL changes teaching methods employed by language teachers. Hai-peng and Li-jing (2007) claim that language teachers have been turning book-oriented classes into students-oriented classes. This feature of CALL contributes to students’ self-confidence and autonomy.

As it is clear that CALL has a place in language learning, it is valid for language acquisition, as well. Kavčič et al. (2006, p. 95) inserts that CALL has three different roles in language acquisition and the computer can act as:

- a tutor (e.g. for delivering instructional materials to the learner),
- a stimulus (e.g. to stimulate discussion, writing, or critical thinking), or
- a tool (e.g. word processors, spelling and grammar checkers, and concordances).

Presenting these roles, it is inevitable to make use of computers in language classrooms in this age of technology. That’s why CALL should be integrated into the curriculum of language courses. Similarly, Ayres (2002: 248) suggests that “CALL is a tool to supplement the classroom, and needs to be tied into the curriculum closely”. The studies carried out by McCarthy (1999) and Redfield and Campbell (2002) proved that integration of CALL into curriculum worked effectively (cited in O’Connor and Gatton, 2004).

All things considered, there are lots of plausible reasons to use CALL in the language learning process. Baş and Kuzucu (2009) list some of them: “experiential learning, motivation, enhancement of student achievement, authentic materials for study, greater instruction, individualization, independence from single source of information and global understanding” (para.8).
Computers and Vocabulary Learning
In the language learning process, it is really a challenge to teach the basic skill of a language, vocabulary. Computers are like safeguards in overcoming this challenge. There are numerous ways for using computers in vocabulary learning such as dictionaries available on CD-ROMs, websites including vocabulary games, exercises, activities and tests, reading passages that enable students to learn words in a context, online dictionaries with a huge amount of words, spoken and written language corpora, concordances, and various computer programmes like CAVOCA\(^1\). Multimedia glosses are among the popular ways of using computers in vocabulary learning. Lin (2009) states that using glosses and multimedia annotations are found to be effective in vocabulary learning according to results of some studies.

Ma and Kelly (2006) assert that learning vocabulary is one of the most popular subjects in CALL programs. There have been lots of studies conducted till today. The researchers (Ellis, 1995; Goodfellow, 1995; Conrad, 1996) with their studies proved that remarkable interest has been given on vocabulary learning in CALL (cited in Ghabanchi and Anbarestani, 2008).

1.1. Why animation?
Using animation is an easy way to integrate computers into a foreign language classroom. Since this kind of multimedia tool provides students with learning via multi-sensory channels, it is thought that language learning process can be more fruitful and encouraging for students. Collin and Rayen affirms that (2009, p. 396) “The advent of the high-powered multimedia kept the learner close to authentic situations where learning simultaneously involved listening, seeing, reflecting, doing and participating”. Unlike the traditional method of teaching, employing animations in classrooms aids students in understanding since they appeal to both visual and audial memory. Learning with animation is theoretically based on dual-coding theory. As it is described by Pavio (2006) the dual-coding states that processing language knowledge in both verbal and visual channels make learning effective. Animation functions by addressing all 5 senses and its interactivity can contribute to students’ autonomous learning. These features mentioned above results in permanent learning as well. In his article indicating benefits of using multimedia in language classrooms, Hoogeveen (1995) states:

‘Firstly, learners respond to multimedia in a complex way and give the feeling of experiencing information instead of simply acquiring it. Secondly, the man-machine is more friendly interaction. Thirdly, students feel more fun from multimedia and learning becomes a happy process.’

(cited in Hai-peng & Li-jing, 2007, p. 56)

As it is stated, students learn by experiencing language knowledge. Joy and learning combine when using animation and the education environment turns into “edutainment” (Boswood, 1997: 202). In his paper about the influence of animation on learners, Devi (2005) lists some positive and negative aspects of using animations.

- Some positive aspects from this study on using animation in learning are given below.
  1. Increases motivation
  2. Removes affective filters
  3. Lowers the anxiety level
  4. Improves contextual comprehension because of the display of caption along with the animation.
  5. Helps in the retention of concepts is superior when compared to the use of just text
  6. Fosters visual and verbal literacy

- A few negative aspects were also observed:
  1. Distracts the learner to watch the cartoon repeatedly.
  2. Affects the learning process if learners with difficulties in vision use it repeatedly.

(Para. 23)

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\(^1\) CAVOCA is an acronym of “Computer Assisted Vocabulary Acquisition”. Groot (2000) describes this programme in his online article. For more information about the programme, please see http://llt.msu.edu/vol4num1/groot/default.html
As it is clearly shown in this list, there are relatively few negative impacts on students in comparison to the great many positive impacts it has on students. Even if it were possible to eliminate all of the negative impacts, these positive impacts are still enough to use animations in language learning process.

Another aspect of using animations in language classrooms is that they make the language courses suitable for students with different learning styles. Butler-Pascoe and Wiburg (2003, p. 7) refer to this aspect of multimedia:

> Multimedia provides the multiple modalities needed to meet the needs of students with different learning styles and strategies. The aural, visual, tactile, and kinaesthetic learners have access to a variety of computer-based activities that are well suited to their preferred learning styles.

Considering various different learning styles in a language class, using multimedia devices like animation can contribute to the motivation level of students in a positive way because all different learners can find something attractive in the language learning process.

**METHODODOLOGY**

**Participants**
The participants in this study were the English preparatory class students at pre-intermediate level attending School of Foreign Languages in Karadeniz Technical University in the academic year 2009-2010. Two pre-intermediate classes were randomly selected as the experimental group (n=17), and control group (n=22) as each class accommodated that number.

**Research Design**
This small scale experimental study aims to find whether any difference exists between the students having a traditional text-based method and those having computer-based method. To do this, an experimental and a control group were formed. Both groups were given the same pre-test including four different part of vocabulary exercises. For the class with traditional method, students were allowed to complete the worksheets including vocabulary exercises in 20 minutes and later the text on water cycle were distributed to read in 10 minutes. At the end of the class, the same worksheets were given the students again and they were allowed to do it in 20 minutes. For the class with computer-based method, students were given the same pre-test and post-test and in the same length of time they were allowed to fulfill the task. The only difference was that this group was shown an animation on the same topic to students. The students watched the animation, heard the utterances and also saw them on the screen.

**Material and Target Words**
For this research, the ‘water cycle’ was chosen as the content for the class. For the control group, a text telling the process of the water cycle was given on a paper. This text included all the target words that were asked in the achievement test. The statements in this text were the same as the utterances in the animation version. Therefore, the students in both the control and the experimental group were introduced to the same content but in different forms. In the animation version, they were moving scenes displaying each phase of the water cycle, students could watch the process, hear and see the utterances simultaneously.

**Instruments**
The instrument for this current study included an achievement test with four different parts. It was prepared by obtaining expert opinions. The same test was used in the pre-tests and immediate post-tests. The test had 40 items including target words regarding the content, water cycle. For the first part, students were asked to complete a puzzle including 12 words. For the second, they were asked to find the match the 7 words given. In the following part, the students were asked to recall the 8 words with its first letter and meaning given. In the last part, students were asked to write the Turkish equivalence of the 13 words given. After the study carried out in both classes, the class teacher who taught both classes was asked about his observations during both applications. Also, students in the experimental group were asked their opinions about learning English and vocabulary via animations. In this way, apart from the tests, opinions were also obtained on this issue.

**Data Analysis**
Each correct answer in the tests was counted one point while the wrong was zero. The maximum score of the test was 40. After the results were obtained, they were analyzed by t-tests in SPSS 16.00. The expected result of this study was that students in the animation group would outperform those in text-based group in the post-tests as compared to the pre-tests.
In this part, the data obtained from the vocabulary tests applied to both groups will be presented. The scores were analyzed independently using t-tests. In the first table, achievement scores and t-values based on the pre-tests and post-tests are compared.

Table 1. Comparison of achievement scores of students in the experimental and control groups

<table>
<thead>
<tr>
<th>Tests</th>
<th>Groups</th>
<th>N</th>
<th>Sd</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>Control</td>
<td>22</td>
<td>20.95</td>
<td>3.99</td>
<td>1.084</td>
</tr>
<tr>
<td></td>
<td>Experiment</td>
<td>17</td>
<td>22.41</td>
<td>4.37</td>
<td></td>
</tr>
<tr>
<td>Post-test</td>
<td>Control</td>
<td>22</td>
<td>21.45</td>
<td>4.44</td>
<td>1.754</td>
</tr>
<tr>
<td></td>
<td>Experiment</td>
<td>17</td>
<td>24.06</td>
<td>4.78</td>
<td></td>
</tr>
</tbody>
</table>

Note. Maximum score = 40

According to the data presented in the table, the average scores of pre-tests applied to experiment group (X \text{experiment} = 22.41) and control group (X \text{control} = 20.95). These results show that there is no statistically significant difference between the average scores of pre-tests applied to both groups when analyzed independently using a t-test (p>0.05). The analysis of post-tests show that there is no statistically significant difference X \text{experiment} = 24.06 ; X \text{control} = 21.45) between the experimental group who learned using animation-based method and those who learned using paper-based text in a traditional language teaching method (p>0.05).

Table 2. Comparison of Pre-test and Post-test achievement scores of students in the experimental group

<table>
<thead>
<tr>
<th>Tests</th>
<th>N</th>
<th>Sd</th>
<th>df</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>17</td>
<td>22.41</td>
<td>4.37</td>
<td>16</td>
<td>-2.297</td>
</tr>
<tr>
<td>Post-test</td>
<td>17</td>
<td>24.06</td>
<td>4.78</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is seen that in table 2, the average score of pre-tests applied to experiment group is x =22.41 and the average score of post-tests of the same group is x =24.06. To determine whether there is a statistically significant difference between the average scores of both pre and post-tests applied to this experiment group, the results were analyzed using a dependent t-test analysis. This analysis shows that t(16) =-2.297 and p<0.05 (.035). Considering the total score of the tests as 40, it can be claimed that there is a statistically significant difference between the average scores of pre-tests and post-tests applied to this experiment group.

Table 3. Comparison of Pre-test and Post-test achievement scores of students in control group

<table>
<thead>
<tr>
<th>Tests</th>
<th>N</th>
<th>Sd</th>
<th>df</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>22</td>
<td>20.95</td>
<td>3.99</td>
<td>21</td>
<td>-0.807</td>
</tr>
<tr>
<td>Post-test</td>
<td>22</td>
<td>21.45</td>
<td>4.44</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3 presents that the average score of pre-tests applied to control group is x =20.95 and the average score of post-tests is x =21.45. According to the dependent t-test analysis used to see if there is any difference between these average scores, the results are t(21) =-0.807 and p>0.05 (.429). These results affirm that there is no statistically significant difference between the average scores of pre-tests and post-tests applied to the group who employed paper-based text in a traditional way.

The analysis of the data implies that while there is a statistically significant difference between pre-tests and post- tests of the experimental group, there is no statistically significant difference between the experimental group who learned using animation-based method and those who learned using paper-based text in a traditional language teaching method.

**Observations of the Teacher and Students’ Opinions**

During the applications in both classes, neither group was given any extra instruction or any information on the content. The teacher has no role as a tutor but a guide to direct students to complete the tasks. When the teacher was asked his observations about both groups he stated that there was considerably more enthusiasm for the activity presented in animation-based method as compared to the one presented in traditionally paper-based method. The students to whom the text is presented on paper complained about having difficulty understanding the text and words. They expressed that they needed to refer to a dictionary for the unfamiliar words. On the other hand, in animation-based class, the students were more excited and more eager to learn. They were trying to focus on the issue presented in animation. They did not tell anything regarding a need to use dictionary.
When students in animation-based class were asked about their opinions at the end of the application, they were positive about the application in general. They found the animation activity useful. To characterize the common view some quotations were given as follows:

“It has positive impact on learning. Meanings of words are catchier for us since we can make inferences to understand the meanings of words.” (informant 17)

“Both seeing and hearing make learning and remembering words easier. Also, we can infer the meaning from the visuals in the animation.” (informant 12)

“We can comprehend a context full of unfamiliar words not just by reading but also seeing and hearing in easier way.” (informant 8)

“This is a better method in learning words than learning words on a paper-based text.”(informant 3)

Some students, though finding it interesting, still wanted to have some extra information on paper in hand (informant 14). Furthermore, one of them found the animation difficult to follow as the subtitles were changing in different phases of water cycle too fast, making it difficult to understand. However, same student found this animation activity useful for acquiring words (informant 11).

CONCLUSION
The findings showed that there is no statistically significant difference in scores of achievement tests between the control group students who worked on vocabulary on paper and the experimental group on animation form. However, it is clear from the tests scores that experimental group outperformed control group indicating that animation-based technique contributed to students’ vocabulary learning. As indicated in students’ self-reports animation-based technique allowed the students to use both aural and visual channels while dealing with the task. The findings of teacher’s observations and opinions of students also show that there was a common positive attitude towards using animations in the class. At the end of the animation application, students became aware of its contribution to their vocabulary knowledge. They wanted to see such kind of activities more often since they attracted students’ attention and motivated them for learning.

It appears that there is a need for further research to fully investigate the efficacy of using animations in vocabulary learning with a larger sample. The use of animation can be extended to the other language skills as well, including grammar.

It is concluded that animations may assist students in learning vocabulary but it is important to know how and where to decide using them. Animation should not be allowed to monopolize the whole session. On the contrary, it should be considered as a motivator and powerful tool that aids learning process. It should not be regarded as an alternative way replacing with traditional method totally, but as an additional technique to use for the class.

REFERENCES


A WEB-BASED ASSESSMENT FOR PHONOLOGICAL AWARENESS, RAPID AUTOMATIZED NAMING (RAN) AND LEARNING TO READ CHINESE

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ABSTRACT
The present study examined the equivalency of conventional and web-based tests in reading Chinese. Phonological awareness, rapid automatized naming (RAN), reading accuracy, and reading fluency tests were administered to 93 grade 6 children in Taiwan with both test versions (paper-pencil and web-based). The results suggest that conventional and web-based versions were equally predictive of Chinese reading measures. However, the equivalency of the two testing mediums was found with RAN only.

INTRODUCTION
Despite the establishment of phonological awareness as sine qua non for reading alphabetic languages (see reviews in Adams, 1990; Torgesen & Mathes, 2000; Wagner & Torgesen, 1987), studies have shown that phonological awareness skills are associated and predictive of Chinese reading (Chen, Hao, Geva, Zhu, & Shu, 2009; Ho & Bryant, 1997a, 1997b; Huang & Hanley, 1995; Hu & Catts, 1998; Li, Anderson, Nagy, & Zhang, 2002; Liao, Georgiou, & Parrila, 2008; McBride-Chang & Zhong, 2003; Siok & Fletcher, 2001; Shu, Peng, & McBride-Chang, 2008; Tong & McBride-Chang, 2010). Phonological awareness, the sensitivity to the sound structure of a language and the ability to manipulate segments of words, is often measured by tasks that involve analyzing, synthesizing, and categorizing speech sounds of one’s language (Wagner et al., 1997; Wagner, Torgesen, & Rashotte, 1994; Wagner & Torgesen, 1987).

Chinese syllables are conventionally dissected into onsets (initial sound) and rimes (final sound), thus, reading studies in Chinese usually focus on awareness of three sound units: syllables, onsets, and rimes (Li et al., 2002; Lu, 2003). In Taiwan, for example, there are 21 symbols for the initial sounds (onsets) and 16 symbols for the final sounds (rimes) in the phonetic system used in the early years of primary school (Zhu-Yin-Fu-Hao, which literally means “phonetic symbols” in Chinese). For beginning readers, at least, the ability to perceive and manipulate subsyllabic phonological units is required to acquire basic reading skills. Generally, syllable awareness tasks are often used to assess sensitivity of sound with preschoolers (e.g. McBride-Chang and Ho, 2000; McBride-Chang & Zhong, 2003; McBride-Chang, Tong, Shu, Wong, Leung, & Tardif, 2008; Shu et al., 2008; Tong, McBride-Chang, Shu, & Wong, 2009) while onset and rime awareness tasks are more frequently used with children who have received formal reading instruction (e.g. Chen et al., 2009; Chen, 2010; Liao et al., 2008; Siok & Fletcher, 2001; Tsai & Liao, 2010; Tong & McBride-Chang, 2010).

Converging Chinese reading research has demonstrated positive relations between onset and rime awareness and character recognition (Chen, 2010; Ho, 1997; Ho & Bryant, 1997a, 1997b; Ho, Wong, & Chan, 1999; Huang & Hanley, 1997; Hu & Catts, 1998; Liao et al., 2008; Siok & Fletcher, 2001; Tsai & Liao, 2010; So & Siegel, 1997). Chen (2010), for example, found that onset and rime awareness correlated with and predicted character recognition with 102 fourth graders in Taiwan. After age, IQ, and rapid naming were controlled, onset and rime awareness still accounted for an additional 7.3% of the variance in character recognition. Similarly, Siok and Fletcher (2001) measured phonological awareness with an oddity test (onset and rime level) and found that onset and rime awareness correlated with and predicted 22% and 15%, respectively, significant amount of variance in character reading, independent of non-verbal intelligence in grade 2 and grade 5.

In addition to the significant contribution of phonological awareness to reading, a substantial body of evidence has shown that rapid automatized naming (RAN) is related to and account for unique variance in alphabetic reading performance (e.g., Blachman, 1984; Compton, 2003; de Jong & van der Leij, 1999; Kirby, Parrila, & Pfeiffer, 2003; Manis, Doi, & Bhadha, 2000; Parrila, Kirby, & McQuarrie, 2004; Sprugevica & Høien, 2004; Torgesen, Wagner, Rashotte, Burgess, & Hecht, 1997; Wagner & Torgesen, 1987). Generally, rapid automatized naming (RAN) refers to how fast a person can continuously name a set of familiar stimuli on a page (Wolf & Bowers, 1999). The key components of this definition of RAN are that the stimuli are name...
continuously from the first to the last, and that they are extremely familiar to the participants (Kirby, Georgiou, Martinussen, & Parrila, 2010). Studies have shown that correlations are usually lower between discrete trials of naming (the stimuli are presented and named individually) and literacy skills than continuous naming (de Jong, 2009; Torgesen, Wagner, & Rashotte, 1994; Wagner et al., 1997). This phenomenon may as well indicate the closely relationship between the underlying processes of RAN and the behaviour of reading.

Existing literature supports the imperative role of RAN to nonalphabetic Chinese (Chen, 2010; Chow, McBride-Chang, & Burgess, 2005; Hu & Catts, 1998; Kang, 2004; Liao et al., 2008; McBride-Chang, Chow, Zhong, Burgess, & Hayward, 2005; McBride-Chang & Ho, 2000; McBride-Chang & Kail, 2002; McBride-Chang, Shu, Zhou, Wat, & Wagner, 2003; Tan, Spinks, Eden, Perfetti, and Siok, 2005; Tsai & Liao, 2010; Wang, 2005). Studies attempting to account for the relationship between RAN, the ability to name highly familiar symbols or stimuli (letters, numbers, colours, or pictured objects) as fast as possible, and Chinese reading shows that (1) RAN correlates significantly with character recognition among beginning readers in Taiwan (Hu & Catts, 1998; Liao et al., 2008; Tsai & Liao, 2010), Hong Kong (Chow et al., 2005; McBride-Chang & Ho, 2000; McBride-Chang & Kail, 2002; McBride-Chang et al., 2003; McBride-Chang & Zhong, 2003; McBride-Chang et al., 2008; Tong et al., 2009) and China (McBride-Chang et al. 2005; Wang, 2005); (2) RAN predicts character recognition (Hu & Catts, 1998; McBride-Chang et al., 2003; Tan et al., 2005) and character and word reading fluency (Chen, 2010; Kang, 2004; Liao et al. 2008; Tsai & Liao, 2010) concurrently (3) RAN contributes longitudinally to character recognition (McBride-Chang & Zhong, 2003; Tong et al., 2009; Wang, 2005) and paragraph reading fluency (Wang, 2005); (4) RAN deficits is one of the dominant cognitive deficits in Chinese developmental dyslexia (Chan, Ho, Tsang, Lee, & Chung, 2007; Ho, Chan, Tsang, & Lee, 2002; Ho, Chan, Lee, Tsang, & Luan, 2004).

In addition to the important roles of phonological awareness and RAN to reading success, the utility of these constructs to identify potential reading deficits is well-acknowledged. Phonological awareness and RAN are often used for diagnosing children with reading disabilities not only because they distinguish good and poor readers but also these tasks can be administered to children as young as four, which make them ideal screening and diagnosis instruments for early identification and early intervention (Chan et al., 2007; Ho et al., 2002; Ho et al., 2004; Lu, 2003). Reading is a complex activity and there are multiple factors contribute to reading failure, such as weaknesses in phonological awareness, RAN, orthographic processing, and morphological awareness (e.g. Ho et al., 2004; Lu, 2003; Shu, McBride-Chang, Wu, & Liu, 2006). However, among these factors, phonological awareness and RAN are particularly important theoretically because of the proposed double-deficit hypothesis by Wolf and Bowers (1999). According to the hypothesis, individuals with deficits in both phonological awareness and RAN will experience more severe reading difficulties than individuals with only one of the deficits.

Conventionally, phonological awareness is assessed individually by presenting the items orally by the experimenter. For example, in a rime awareness task, after hearing the four syllables “cat, rat, dear, mat”, children are asked to choose the syllable that has the different rime. RAN, on the other hand, is conventionally assessed individually with stimuli equally distributed in rows on a paper or on a computer screen. Four types of stimuli, colours, pictures, digits and letters, are used most often in RAN tasks. Participants are asked to name the items as fast and accurately as possible. The response time (RT) is measured by the onset of the first item to the last stimuli named by a stopwatch and errors are recorded manually. For example, a child may be shown a page of 50 Arabic numerals (e.g., 2, 4, 5, 7, 9) equally distributed in five rows in semi-random order with 10 items in each row and asked to name them as fast and accurate as possible. The score of the task is the total time spent in reading the 50 digits.

Even though conventional test versions of phonological awareness and RAN are widely used in reading research, there are disadvantages and limitations in the existing formats, including limited sample size, inaccurate response time and error scoring, inconsistent presentation, and higher chance of human error. Limited sample size, for example, eliminates the efficiency and sufficiency of the tests to screen a large number of children at young age and identify those manifest potential symptoms of reading difficulties as early as possible. Conventional test versions require individual testing. Both time and labour constraints make school-wide testing unachievable, which in turn reduce the efficacy of early identification and early intervention. Inaccurate RT and error scoring might occur due to inadequate test administration, and false judgment of the onset/end of naming, and error identification during testing. Consistent presentation is particularly important for phonological awareness since all the test items are presented orally by the experimenter to the participants. Thus, consistency between trials and participants needs to be met to ensure reliable results obtained. Finally, conventional tests involve large amount of human supervision which increases the probability of unexpected errors during the process of testing.
To summarize, the purposes of the present study are: first, to eliminate the limitations of conventional test versions by developing web-based phonological awareness and RAN tests; second, to examine the equivalency of conventional and web-based phonological awareness and RAN tasks to Chinese reading performance; and finally, to investigate and to compare the contributions of the two test versions to character recognition and word reading fluency. Given what the existing studies in reading research, we expected that the web-based test system will become valuable tools to the Assessment and Research community by providing:

1. uniform oral and visual presentation,
2. precise response time and error scoring
3. fast and simultaneous results and analyses
4. easy access of tests in remote areas
5. large group sampling
6. early identification and early intervention for children with reading difficulties

To our knowledge, the present study is the first study to examine web-based assessment in phonological awareness, RAN and reading skills. The advantages of web-based tests would improve the existing screening and diagnosis system of reading disabilities, and moreover, provide researchers more accessible and convenient tools for conducting empirical studies.

METHOD

Materials and procedures

All participants were assessed on a nonverbal intelligence test, two reading tasks (character recognition, one-minute word reading), two phonological awareness tasks (onset detection, rhyme detection), and two RAN tasks (RAN colours, RAN digits). For the two reading tasks, character recognition was administered with the paper-pencil version and one-minute word reading was administered with the web-based version. For phonological awareness and RAN tasks, with the same test items, both web-based and paper-pencil versions were used.

Nonverbal Intelligence. A measure of nonverbal intelligence was included in the present study because some previous studies have found that Chinese reading is significantly correlated with IQ (e.g., Huang & Hanley, 1995; 1997). Raven’s standard progressive Matrices (Raven, Court, & Raven, 1998) was used to assess nonverbal intelligence in this study. The test required participants to select one of six to eight options that best completed a matrix with a part missing. There are five sets of 12 items each in the test. Scoring procedures were based on the local norm established in 2006.

Graded Chinese Character Recognition Test (Character Recognition; Huang, 2001). This is a standardized group administered reading measure with 200 single-syllable characters graded in difficulty. The test is frequently used in Taiwan for measuring reading abilities in grades 1 to 9. Participants were asked to write down the name of the character next to it using Zhu-Yin-Fu-Hao, which is the phonetic system used in Taiwan. Children started to learn the phonetic system in the beginning of grade 1 and used it till grade 6. Thus, first graders have already acquired the skills in converting Chinese syllables in writing by using Zhu-Yin-Fu Hao. The score of the test was the number of characters answered correctly.

One-Minute Word Reading. The web-based test consisted of 100 familiar Chinese two-character words (see Figure 2). Children were instructed to read the words as fast and accurately as possible in one minute after the beeping sound occurred (see Figure 1). After the beep, the system started recording. Children who finished reading within one minute would press the space bar to terminate recording. The test stopped mandatorily while one minute is reached and the sound file was sent to and saved by the server for scoring and further analysis. The score was the number of words read correctly within one minute.
Onset Detection. The task was developed to assess children’s sensitivity to the onsets of Chinese syllables. Detection of the initial sound of Chinese syllables was employed because of the presumed onset and rime characteristic of Chinese syllables. Chinese single-syllable words were used in the task. There were 2 practice trials and 12 test trials. Tones of syllables were controlled such that all four syllables in each trial were in the same tone. Children were instructed to wear earphones before the test. After listening to the four syllables, children were asked to press the number keys (1, 2, 3, 4) which syllable had the different onset (see Figure 3). For example, after listening to [fu]膚, [ma]媽, [mi]咪, [mau]貓, children were supposed to press “1” which had the different onset than the other three. Each test item was presented twice. The font size of the number options became larger when a syllable was presented. The function was specially designed as a reminder to the participants, and at the same time, to decrease the memory load.

Rhyme Detection. The task was developed to assess children’s sensitivity to the rimes of Chinese syllables.
Chinese single-syllable words were used in the task. There were 2 practice trials and 12 test trials. Tones of syllables were controlled such that all four syllables in each trial were in the same tone. The testing procedure was the same as Onset Detection.

**Rapid Automatized Naming (RAN).** Two rapid naming tasks were used in the present study: colour naming (RAN Colours) and digit naming (RAN Digits). Each naming task contained 50 stimuli presented on a computer screen (see Figure 4). RAN Colours involved five colours, namely black, red, yellow, blue, and green. RAN Digits involved five numbers, 2, 4, 5, 7, and 9 (see Figure 5). In all tasks, the items were equally distributed in five rows with 10 items in each row. A practice trial preceded each test trial to ensure familiarity with the stimuli. Children were asked to wear the earphone with a microphone, to name the items as fast and accurately as possible after the beeping sound occurs, and to press the space bar when the last stimulus was read to stop recording. The sound file was then sent to and saved by the server for scoring and further analysis.

![Figure 3. Interface of Onset and Rhyme Detection](image1)

In the Onset and Rhyme Detection task, the font size of the number options becomes larger when a syllable is presented.

![Figure 4. Interface of RAN Colours](image2)

This picture shows 50 stimuli consisted of five colours and the participant read it from left to right and from top to bottom as fast and accurately as possible.

When colour naming is finished, press the space bar to stop recording.
Implementation of web-based phonological awareness and RAN assessment system

The proposed web-based phonological awareness and RAN assessment system has been implemented based on PHP and MySQL with APACHE web servers. Figure 6 shows the system architecture which consists of 9 modules: Account Management Module, Item Bank Management Module, Test Management Module, Scoring Module, Test Module, Test Report Module, User-profile Database, Item Bank Database, and Test Result Database.

The Account Management Module provides creation and management of user accounts. The functions of Item Bank Management Module include the creation, modification, and deletion of items. The function of Test Management Module is to arrange test battery and test administration process. After finishing the test, the Scoring Module evaluates responses and computes the domain scores automatically. The Test Report Module is used to generate the report of diagnosing results for each examinee.

When digit naming is finished, press the space bar to stop recording.
Participants
Participants were 93 (52 boys, 41 girls) grade six students from 3 classes of an elementary school in Taichung, Taiwan. The mean age of the participants was 12.3 years (range 11.75 to 12.8, SD =3.54). None of the children was previously diagnosed with any emotional, behavioural or sensory difficulties.

RESULTS
Descriptive statistics for all the variables used in this study are presented in Table 1. The correlations (rs) amongst variables on conventional testing session showed that, overall, the two reading measures, Character Recognition and One-Minute reading correlated significantly with nonverbal IQ, Onset Detection (not in the case of One-Minute Reading), Rhyme Detection (rs = .25 to .34), RAN Digits (rs = -.22 to -.58), and RAN Colours (rs = -.23 to -.48). An examination of the correlations between phonological awareness and RAN revealed that only Rhyme Detection and RAN Colour was mildly associated (r= -.22; see Table 2).

In the web-based testing session, significant associations were found between Character Recognition and nonverbal IQ, One-Minute Reading (r = .27), Onset Detection (r = .27) Rhyme Detection (r = .34), and RAN Colour(r = -.24); whereas One-Minute Reading correlated significantly with both RAN tasks (rs = -.34 to -.62) but not with phonological awareness measures. Moreover, no associations were found between phonological awareness and RAN in the web-based session (see Table 3).

An important goal for the present study was to investigate the equivalency between conventional and web-based tests. Correlations between scores on conventional and web-based phonological awareness and RAN tasks were presented in Table 4. The results showed that the two test mediums are highly correlated (rs = .77 to .84) for RAN, suggesting that children’s performance were comparable in these two sessions. However, the same was not found with phonological awareness measures. Only Rhyme Detection was moderately associated, whereas no equivalency was found for Onset Detection. The low associations on the two phonological awareness tests in the conventional and web-based sessions indicated the possibility of inconsistent item presentation between the two testing mediums.

To examine the contribution of phonological awareness and RAN to reading, two separate fixed-order hierarchical multiple regression analyses were conducted (see Table 5 and Table 6). In all regression analyses, age and nonverbal IQ were entered first, followed by phonological awareness tasks (both Onsets and Rhyme Detection entered simultaneously), and RAN tasks (both RAN Digits and RAN Colours entered simultaneously). For the equations predicting Character Recognition, phonological awareness tasks explained an additional 8.3 % and 6.4% of the variance, respectively, on conventional and web-based tests, after age and nonverbal IQ were controlled. However, no significant amount of variance was found with RAN in step 3 on both sessions.

To predict One-Minute Reading, RAN explained 31% and 34.5% of the unique variance after age, nonverbal IQ, and phonological awareness scores were controlled. In contrast to what was found for Character Recognition, phonological awareness was not a significant predictor in step 2. The total variance accounted for by all predictors was 40.7% and 41.2 %, respectively, on conventional and web-based sessions.

DISCUSSION
Investigating the relationship between phonological awareness, RAN, reading accuracy, and reading fluency, the results, in general, are in line with previous studies showing that phonological awareness tasks are associated with Chinese reading measures (e.g., Huang & Hanley, 1997; Hu & Catts, 1998; Siok & Fletcher, 2001; So & Siegel, 1997; Tong & McBride-Chang, 2010; Tsai & Liao, 2010; Wang, 2005). Thus, for six graders, being sensitive to the sound structure is important for word decoding and fluent reading. However, few inconsistencies were observed in the conventional and web-based tests, particularly with the correlations between Onset Detection and reading scores. A low and non-significant correlation of .048 was found between Onset Detection and Character Recognition on conventional session (compare to web-based session, r = .27, p <0.01) and a low correlation of .061 was found between Onset Detection and One-Minute reading on web-based session (compare to conventional session, r = .22, p <0.05). Moreover, the correlation coefficients show that Rhyme Detection is a stronger and more stable correlate to Chinese reading accuracy and fluency than Onset Detection suggesting that Rhyme Detection might be more representative than Onset Detection to assess phonological awareness skills. This finding is in line with previous studies with third graders in Hong Kong (Kang, 2004) and fourth graders in Taiwan (Tsai & Liao, 2010).

The results of RAN tasks in the present study are in agreement with previous work (Chow et al., 2005; Hu & Catts, 1998; McBride-Chang & Ho, 2000; McBride-Chang & Kail, 2002; McBride-Chang et al., 2003;
To summarize, the equivalency between conventional and web-based test versions of phonological awareness bank updating.

accurate and consistent presentation and instruction, and finally allowing simultaneous data analyses and item widescale utility of RAN by reducing the need of labour, increasing the number of participants, guaranteeing tasks were designed to assess a large group of sample at the same time which in turn makes the most of the sixty-two university students. However, it should be noted that in Howe’s study, the main difference between her colleagues (Howe, Arnell, Klein, Joanisse, and Tannock, 2006) reported a very high correlation with her colleagues’ RAN test. Howe and her colleagues (Howe, Arnell, Klein, Joanisse, and Tannock, 2006) reported a very high correlation with her colleagues’ RAN test. Howe and her colleagues (Howe, Arnell, Klein, Joanisse, and Tannock, 2006) reported a very high correlation with her colleagues’ RAN test. Howe and her colleagues (Howe, Arnell, Klein, Joanisse, and Tannock, 2006) reported a very high correlation with her colleagues’ RAN test. Howe and her colleagues (Howe, Arnell, Klein, Joanisse, and Tannock, 2006) reported a very high correlation with her colleagues’ RAN test.

In contrast to phonological awareness tests, the present study shows high equivalency between conventional and web-based phonological awareness tests, further work should attempt to examine both types of test mediums.

To examine the relative contributions of phonological awareness, RAN, and reading measures, hierarchical regression analyses were conducted. The results show that phonological awareness explained unique variance in reading accuracy, while RAN predicted reading fluency beyond what was accounted for by the controlled variables in both testing sessions. These findings are in line with previous studies showing that phonological awareness predicts character recognition (e.g., Huang & Hanley, 1997; Ho & Bryant, 1997; Siok & Fletcher, 2001; Shu et al., 2008) and RAN predicts word reading fluency (e.g., Kang, 2004, Liao et al., 2008; Liao, 2006; Tsai & Liao, 2010). One possible explanation for the different roles play by phonological awareness and rapid naming in Chinese reading is that there are different underlying processes involved in the two reading measures for grade six children. Character Recognition, which assesses the number of characters children have acquired, requires the derivation of the pronunciation of each character that inclined largely on the phonological information of mental lexicon. Therefore, it is not surprising to see that phonological awareness tasks explained the variability of reading accuracy. In contrast, One-Minute Word Reading (reading fluency), which consisted of 100 two-character words, was developed to assess the rate of processing familiar Chinese words requires operations that are also involved in RAN, which is the ability to name highly familiar symbols or stimuli. To sum up, in the present study, the two test versions of phonological awareness and RAN are equivalent in accounting the variance in reading accuracy and fluency in Chinese.

To examine the equivalency of conventional and web-based tests, the low correlations between conventional and web-based phonological awareness tasks (rs = .094 to .401) suggest that the two phonological awareness testing modes are inequivalent, which in turn contribute to the inconsistent correlations reported above. The conventional phonological awareness tasks were presented orally by the experimenters who were the homeroom teachers of the participants. Even though the teachers were trained prior testing to follow the instruction, disparities regarding individual accent, tone, speed, volume, and expression, compared to uniform presentation on web session, would produce different outcomes. Adding to that, children may well select an answer by observing teacher’s lip movement for articulation. To our knowledge, no existing studies have reported equivalency between conventional and web-based phonological awareness tests, further work should attempt to examine both types of test mediums.

In contrast to phonological awareness tests, the present study shows high equivalency between conventional and web-based RAN scores (rs = .771 to .844), suggesting the interchangeability of the two RAN versions. In a comparable study investigating the equivalency between conventional and computerized RAN tests, Howe and her colleagues (Howe, Arnell, Klein, Joanisse, and Tannock, 2006) reported a very high correlation with sixty-two university students. However, it should be noted that in Howe’s study, the main difference between the conventional and computerized (English) RAN tests was the apparatus used to display the stimuli (computer versus paper) since both test sessions were administered individually. In our web-based session, Chinese RAN tasks were designed to assess a large group of sample at the same time which in turn makes the most of the widespread utility of RAN by reducing the need of labour, increasing the number of participants, guaranteeing accurate and consistent presentation and instruction, and finally allowing simultaneous data analyses and item bank updating.

To summarize, the equivalency between conventional and web-based test versions of phonological awareness
tasks and RAN tasks is partially established in the present study. The two test modes of phonological awareness and RAN are equivalent in explaining the variability in reading accuracy and fluency in Chinese, and the high correlations between conventional and web-based RAN scores suggesting the interchangeability of the two RAN test mediums, but the same was not found for phonological awareness tasks. Future studies should be more cautious of human presentation of test items to ensure the uniformity of testing procedure.

Table 1. Descriptive Statistics for All Variables

<table>
<thead>
<tr>
<th></th>
<th>Conventional Versions</th>
<th></th>
<th>Web-based Versions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Age(months)</td>
<td>141</td>
<td>154</td>
<td>147.65</td>
<td>3.541</td>
</tr>
<tr>
<td>IQ</td>
<td>27</td>
<td>59</td>
<td>44.27</td>
<td>6.752</td>
</tr>
<tr>
<td>Character Recognition</td>
<td>75</td>
<td>180</td>
<td>133.69</td>
<td>27.504</td>
</tr>
<tr>
<td>One-Minute Reading</td>
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<td>160</td>
<td>108.68</td>
<td>20.524</td>
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<tr>
<td>Onset Detection</td>
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<td>12</td>
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<td>2.044</td>
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<td>Rhyme Detection</td>
<td>4</td>
<td>12</td>
<td>9.74</td>
<td>2.363</td>
</tr>
<tr>
<td>RAN Digits (seconds)</td>
<td>9.45</td>
<td>23.38</td>
<td>16.3617</td>
<td>3.33495</td>
</tr>
<tr>
<td>RAN Colours (seconds)</td>
<td>20.37</td>
<td>51.03</td>
<td>34.8033</td>
<td>7.59725</td>
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</table>

Table 2. Intercorrelations Between the Variables on Conventional Testing Session

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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>7</th>
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<tbody>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>Character Recognition</td>
<td>.336**</td>
<td>1</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>One-Minute Reading</td>
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<td>.329**</td>
<td>1</td>
<td></td>
<td></td>
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<tr>
<td>Onset Detection</td>
<td>.330**</td>
<td>.048</td>
<td>.223*</td>
<td>1</td>
<td></td>
<td></td>
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<tr>
<td>Rhyme Detection</td>
<td>.250</td>
<td>.343**</td>
<td>.249*</td>
<td>.359**</td>
<td>1</td>
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<td></td>
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<tr>
<td>RAN Digits (RT)</td>
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<td>-.218*</td>
<td>-.582**</td>
<td>-.089</td>
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<tr>
<td>RAN Colours (RT)</td>
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<td>-.226*</td>
<td>-.484**</td>
<td>-.139</td>
<td>-.224*</td>
<td>.542**</td>
<td>1</td>
</tr>
</tbody>
</table>

*** p-value<0.001   ** p-value<0.01   * p-value<0.05

Table 3. Intercorrelations Between the Variables on Web-based Testing Session

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>IQ</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Character Recognition</td>
<td>.336**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One-Minute Reading</td>
<td>.207*</td>
<td>.329**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onset Detection</td>
<td>.220</td>
<td>.273**</td>
<td>.061</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhyme Detection</td>
<td>.292**</td>
<td>.340**</td>
<td>.198</td>
<td>.418**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAN Digits (RT)</td>
<td>-.114</td>
<td>-.193</td>
<td>-.616**</td>
<td>.029</td>
<td>-.142</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>RAN Colours (RT)</td>
<td>-.188</td>
<td>-.241*</td>
<td>-.336**</td>
<td>.025</td>
<td>-.120</td>
<td>.407**</td>
<td>1</td>
</tr>
</tbody>
</table>

*** p-value<0.001   ** p-value<0.01   * p-value<0.05
Table 5. Hierarchical Regression for Predicting Character Recognition on Conventional and Web-based Sessions

<table>
<thead>
<tr>
<th>Step</th>
<th>Variables</th>
<th>Conventional</th>
<th></th>
<th></th>
<th>Web-based</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Adjusted R²</td>
<td>R²</td>
<td>R² change</td>
<td>Adjusted R²</td>
<td>R²</td>
<td>R² change</td>
</tr>
<tr>
<td>1</td>
<td>Age, IQ</td>
<td>.115</td>
<td>.134</td>
<td>.134**</td>
<td>.115</td>
<td>.135</td>
<td>.135**</td>
</tr>
<tr>
<td>2</td>
<td>Phonological Awareness</td>
<td>.182</td>
<td>.217</td>
<td>.083*</td>
<td>.162</td>
<td>.199</td>
<td>.064*</td>
</tr>
<tr>
<td>3</td>
<td>RAN</td>
<td>.183</td>
<td>.236</td>
<td>.019</td>
<td>.181</td>
<td>.234</td>
<td>.035</td>
</tr>
</tbody>
</table>

*** p-value<0.001   ** p-value<0.01   * p-value<0.05

Table 6. Hierarchical Regression for Predicting One-Minute Reading on Conventional and Web-based Sessions

<table>
<thead>
<tr>
<th>Step</th>
<th>Variables</th>
<th>Conventional</th>
<th></th>
<th></th>
<th>Web-based</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Adjusted R²</td>
<td>R²</td>
<td>R² change</td>
<td>Adjusted R²</td>
<td>R²</td>
<td>R²</td>
</tr>
<tr>
<td>1</td>
<td>Age, IQ</td>
<td>.023</td>
<td>.044</td>
<td>.044</td>
<td>.022</td>
<td>.043</td>
<td>.043</td>
</tr>
<tr>
<td>2</td>
<td>Phonological Awareness</td>
<td>.057</td>
<td>.098</td>
<td>.054</td>
<td>.024</td>
<td>.067</td>
<td>.024</td>
</tr>
<tr>
<td>3</td>
<td>RAN</td>
<td>.366</td>
<td>.407</td>
<td>.310***</td>
<td>.371</td>
<td>.412</td>
<td>.345**</td>
</tr>
</tbody>
</table>

*** p-value <0.001   ** p-value <0.01   * p-value <0.05

ACKNOWLEDGEMENTS

The authors would like to thank Mr. Ko-Wei Liao for helping data collection and analyses. This work was supported in part by the National Science Council, Taiwan, under Grant 98-2410-H-142-001-MY2.

REFERENCES


ATTITUDES OF SAUDI UNIVERSITIES FACULTY MEMBERS TOWARDS USING LEARNING MANAGEMENT SYSTEM (JUSUR)

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ABSTRACT
The research aims to identify the Attitudes of faculty members at Saudi Universities towards using E-learning Management System JUSUR, which follows the National Center for E-learning. A descriptive analysis was used as a research methodology. (90) participants in this research were asked to complete a 5-point Likert scale questionnaire, which consists of (34) items, classified in three main categories, and (2) items as probe statements. Validity and reliability of the questionnaire were ensured. Statistical treatments such as percentages, means, frequencies, and analysis of variance ANOVA were conducted. The results showed a positive Attitudes of the members of the faculty at Saudi University towards E-learning management system JUSUR, although it has not activated in a sufficient way yet, the results showed how their needs for training in using the system and in particular learning content management and file sharing, forums, and Questions Bank. Moreover, results showed no difference in attitudes towards using the system among the faculty members regarding gender or the types of colleges humanitarian, scientific and health. The paper has 9 tables, 9 shapes, and 20 references.

Key Words: E-learning, Learning management system (LMS), JUSUR, Faculty Members, Attitudes, Saudi universities.

1. INTRODUCTION
The E-learning is an important development taking advantage of computer technologies and software, communications and information, to be employed in the process of teaching and learning, where it has become one of the alternatives in the dissemination of education and activating the training, whether direct or indirect, overcoming the obstacles of space and time and risk, and provided for the teacher’s experiences effectively, enriched the learning and development teaching, and has become a Modern teaching method, employing modern communication mechanisms; to support the educational process, enrich and improve the quality.

The E-learning should not only seen as a set of courses made on the websites, but it is rather a set of teaching and learning management processes, and thus the E-learning is based on computerized systems to manage learning processes, known as Learning Management System (LMS). Software designed to help management of all learning activities in educational institutions, implementation, and evaluation. (Http://www.elc.edu.sa/jusur/jusur_advanced.php).

The daily development in knowledge and technology requires searching for a new formulation of the teaching and learning processes contributing to keep a pace with educational institutions for innovation in technology, in order to use these technologies efficiently and effectively. Faculty members should make the best use of the latest available technology and to stay informed about the latest developments, and transfer what they have learned to new generations of students. (Altun, A., Gulbahar, Y., Madran, O, 2008, p138).

Using technologies in delivering higher education courses represents a real challenge for faculty members to examine their culture of teaching (Travis & Price, 2005). As they should examine the effect of using this technology in all teaching processes and aspects (such as organizing course content, delivery of courses and delivery, evaluation). Literature refers to the importance of learning environments comparing online learning environment and direct face to face one. (Fortune, et al., 2006); (Mooteram, 2006); (Anagnostopoulos, et al., 2005); (Joint, 2005); (Sauers & Walker, 2004), (Renée N. Jefferson, Liz W. Arnold, 2009).

With the development of the E-learning systems, the LMS have become reliable means in teaching and training, in the university or elsewhere, and are used in most universities around the world systems for managing E-learning, whether open source (Moodle), (Dokeos) or closed source, such as (Blackboard), (ATutor). Many Studies indicate that 90% of American universities offer programs through Learning Management Systems (Jones, James G.; Morales, Cesareo; Knezek, Gerald A., 2005, P219).

The LMS is an important tool for the development of curriculum design and management of students’ learning and their motivation to learn (Özdaml, Fezile, 2007, p1). Besides, teaching through the LMS achieves
effectiveness in the development of teaching practices and student learning development (Santos, Olga C.; Boticario, Jesus G., 2007, p1).

The LMS is also useful in the development of student assessment. (Riad, A. & El-Ghareeb, H., 2008, p200). The LMS can manage all teaching and learning processes of registration, scheduling; checking availability of content, tracking the performance of the learner and issuing reports about it, facilitating communication among teachers and learners, through chats, discussion forums, E-mail, and post Files as well as assessment tests and questionnaires.

The LMS allows delivery of scientific material and keeps track of learning and testing, communication and registration processes and study schedules (Cavus, Nadire, 2009, p248). So, it is seen as an integrated system for the management of the educational process, in whole or in part, via the Internet, and includes management courses and communication synchronous and asynchronous tools simultaneously, and manages tests, assignments and registration in courses and follow-up to the student.

Teaching through the LMS helps to achieve effectiveness in the development of both teaching practices and students’ learning. (Santos, Olga C., Boticario, Jesus G., 2007, pp1-2). Using E-learning environment leads to great benefits in integration, interaction and feedback, affecting positively the attitudes of learners in E-learning environment than in normal learning environment. (Jones, James G.; Morales, Cesareo; Knezek, Gerald A., 2005, P219)

Using the LMS also affects positively the attitudes of the faculty members towards special-need students, the knowledge extent of faculty members about these students and the methods of dealing with them through a variety of teaching strategies. (Pollock, Wayne M, 2009, p4)

The reports of (Ohio Learning Network Task force on the future of E-learning) indicate that learners are the main component of developing both teaching and learning through LMSs as they participate in taking responsibility for their learning, varying their creativity continuously; learning occurs in various times and in different behavioral, cognitive, and emotional aspects, and evaluation is done according to the real performance, and the teacher’s role is limited in guidance and counseling without indoctrination, whereas technology plays an active role in the delivery of courses. (Ereny, Tom, 2004).

The LMS consists of two main components, the first is Learning Management System (LMS) and the second is Content Management System (LCMS). Where Learning Management System is shown in (Cavus, Nadire, 2009) as in the following shape:

![Fig (1) describes the structure of the Learning Management System](image)

**Fig (1) describes the structure of the Learning Management System** (Cavus, Nadire, 2009, p249)

**Content Management System**: A Content Management System (CMS) : Lurie (2002) refers to it as: The integration of three different concepts: content, processes, software and technology. The content includes texts, drawings, fixed drawings, animated images, sounds and videos, and media, arranged to become a flexible learning environment to be run by the user. Processes are defined as a range of activities with inputs and outputs...
that allow the user to upload files, publish and share, and need software and technology to perform content control operations across the Internet.

(Altun, A., Gulbahar, Y., Madran, O, 2008) presents map Summarizes the content management system as follows:

![Map work content management system](image)

When selecting a specific system to be used in any institution as a LMS, there are certain procedures for this process including (Cavus, nadire, 2010):
- Selection and identification of user’s needs
- Choosing a range of products required by the user and fulfill his requirements
- Assessing the advantages and disadvantages of each product
- Sorting products in terms of advantages and disadvantages
- Determining the results and selecting the best suitable option for a user’s needs.

The following shape represents this system:

![Illustrates the procedures for selecting the Learning Management System](image)

The Saudi universities keep a pace with developments in the field of the LMS; as most of them have used LMS, whether open source or closed. For overcoming the diversity of these systems and addressing the problems of
development and technical support, the Ministry of Higher Education through the National Centre for E-learning and Distance Education in investigating of reality as well as international experiences. As a result, a national system for the management of E-learning called "JUSUR" has been established, in cooperation with international experts, avoiding the most common defects and problems in LMSs.

The National Center for E-learning and Distance Education has started training of Saudi universities faculty members to use the system and how to activate it in university teaching in Saudi universities. The number of courses offered by most Saudi universities on the system has reached (2336) courses in the first semester of the academic year 2009/2010.

1.1 Advantages of the JUSUR system:

JUSUR System is an integrated software system responsible for managing the E-learning process, including:

- Registration: inserting and managing of students’ data.
- Scheduling: Scheduling of the courses, and developing plans to teach them.
- Delivering: Making content available to the students.
- Tracking: Following-up students’ performance and producing reports.
- Communicating: facilitating communication among students through chats, discussion forums, mail, and post Files.
- Testing: conducting students’ tests and dealing with their assessment.

Learner can, through their own page in JUSUR, access their grades and assignments. On the other hand, a teacher can build Tests and presenting them to students, and keeping degrees automatically in special tables, in addition to a number of other features and services the learner, the teacher, and management.

JUSUR System also includes Learning Content Management System (LCMS), the environment in which they can manage the stores of Learning Units / Learning Objects Learning Object Repository; and using them to develop educational materials. These systems have research capabilities that give developers the chance to search, access texts and media quickly for building learning content.

2. PREVIOUS STUDIES

Renée N. Jefferson, and Liz W. Arnold (2009) In his study, investigated the impact of virtual learning on academic culture, and indicated there is a difference between the perception of faculty members’ facilities and obstacles in the E-learning environment and normal learning environment for the E-learning environment; as faculty members who work in learning environments and do not use E-learning believe that virtual education has significant obstacles and its facilities are very limited.

Altun, A., Gulbahar, Y., Madran, O (2008) investigate perceptions of pre-service teachers about using of a content management system for blended learning, researchers address stages of implementation and evaluating management system to be used in the higher education environment. The study aimed to note the interaction of university students within the system and how their perceptions of using of the system. The research group was composed of (65) university students volunteered to participate in the experiment; researchers used personal interviews and a questionnaire. Data was analyzed using metadata statistics; results showed students’ interaction with using the content management system and that they are eager to using the system in their courses of study.

Cavus, N, Uzunboylu, H, Ibrahim, D (2006) investigates the effectiveness of using learning management systems and collaborative tools in web-based teaching of programming languages, indicated that using the LMS is more efficient and effective if it is equipped with a collaborative learning tool. The study also showed the success of the programming languages courses to achieve its objectives through the LMS and collaborative learning tool.

3. RESEARCH PROBLEM

Despite the technical capabilities offered by the National Centre for E-learning and Distance Education for faculty members to activate using JUSUR; it was noted that teaching through the system has not been activated adequately in most Saudi universities, including King Saud University although it is the most advanced university in using the system as (1283) course of the total (2336), (55%) of the courses, offered through the system. This requires identifying the reasons for this in terms of faculty members, and then to identify their attitudes towards using JUSUR for the management of E-learning and the reason for not activating the system adequately. The research questions are:
1. What are the attitudes of faculty members in Saudi universities towards using LMS - JUSUR?
2. What are the obstacles to use JUSUR from the viewpoint of faculty members in Saudi universities?

4. RESEARCH PROCEDURES

4.1. Building the search tool:
Building attitudes scale of faculty members in Saudi universities towards using JUSUR learning Management System through considering several attitude scales of the E-learning Management Systems, at the Arab and global levels. Based on reviewing the theoretical framework of research and previous scales, the following scale axes have been identified:
- The personal view towards E-learning and JUSUR
- The need to use JUSUR
- The need for training on using JUSUR

4.2. Reliability and Validity of the Scale:
Validity was calculated to the scale through a group of specialists in measurement, evaluation, teaching methods, curricula, and Educational psychology numbered (15) faculty members. Their amendments requested have been modified. The scale in its final form is composed of (34) items and in addition two probe statements. Thus, the scale has (36) items. The responses graded according to five categories (Strongly agree - agree - neutral - refuse - strongly refuse).

The scale has been applied on an exploratory sample from (20) subjects, to calculate reliability and validity of the scale. Internal consistency was calculated through the calculation of correlation of each item with the axis to which it belongs and correlation among axes, the result were as in the following table:

(Table 1) shows the Internal Consistency of the scale in terms of the three axes
- Personal View, the Need to Use, the Need for Training

<table>
<thead>
<tr>
<th>Spearman's rho</th>
<th>The first dimension</th>
<th>Spearman's rho</th>
<th>The second dimension</th>
<th>Spearman's rho</th>
<th>The third dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>v1 Correlation Coefficient</td>
<td>.835 (**)</td>
<td>v2 Correlation Coefficient</td>
<td>.873 (**)</td>
<td>v3 Correlation Coefficient</td>
<td>.741 (**)</td>
</tr>
<tr>
<td>v4 Correlation Coefficient</td>
<td>.835 (**)</td>
<td>v5 Correlation Coefficient</td>
<td>.816 (**)</td>
<td>v6 Correlation Coefficient</td>
<td>.806 (**)</td>
</tr>
<tr>
<td>v7 Correlation Coefficient</td>
<td>-.362 (*)</td>
<td>v8 Correlation Coefficient</td>
<td>.760 (**)</td>
<td>v9 Correlation Coefficient</td>
<td>.799 (**)</td>
</tr>
<tr>
<td>v10 Correlation Coefficient</td>
<td>.740 (**)</td>
<td>v11 Correlation Coefficient</td>
<td>.799 (**)</td>
<td>v12 Correlation Coefficient</td>
<td>.362 (*)</td>
</tr>
<tr>
<td>v13 Correlation Coefficient</td>
<td>.720 (**)</td>
<td>v14 Correlation Coefficient</td>
<td>.707 (**)</td>
<td>v15 Correlation Coefficient</td>
<td>.807 (**)</td>
</tr>
<tr>
<td>v16 Correlation Coefficient</td>
<td>.715 (**)</td>
<td>v17 Correlation Coefficient</td>
<td>.841 (**)</td>
<td>v18 Correlation Coefficient</td>
<td>.888 (**)</td>
</tr>
<tr>
<td>v19 Correlation Coefficient</td>
<td>.756 (**)</td>
<td>v20 Correlation Coefficient</td>
<td>.726 (**)</td>
<td>v21 Correlation Coefficient</td>
<td>.877 (**)</td>
</tr>
<tr>
<td>v22 Correlation Coefficient</td>
<td>.713 (**)</td>
<td>v23 Correlation Coefficient</td>
<td>.715 (**)</td>
<td>v24 Correlation Coefficient</td>
<td>.892 (**)</td>
</tr>
<tr>
<td>v25 Correlation Coefficient</td>
<td>.849 (**)</td>
<td>v26 Correlation Coefficient</td>
<td>.870 (**)</td>
<td>v27 Correlation Coefficient</td>
<td>.880 (**)</td>
</tr>
<tr>
<td>v28 Correlation Coefficient</td>
<td>.860 (**)</td>
<td>v29 Correlation Coefficient</td>
<td>.821 (**)</td>
<td>v30 Correlation Coefficient</td>
<td>.880 (**)</td>
</tr>
</tbody>
</table>
** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

(Table 2) shows the internal consistency of the scale of the axes as a whole

<table>
<thead>
<tr>
<th>Spearman's rho</th>
<th>The first dimension</th>
<th>The second dimension</th>
<th>The third dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>The first dimension</td>
<td>Correlation Coefficient</td>
<td><strong>0.929</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>The second dimension</td>
<td>Correlation Coefficient</td>
<td><strong>0.717</strong></td>
<td><strong>0.719</strong></td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>The third dimension</td>
<td>Correlation Coefficient</td>
<td><strong>0.931</strong></td>
<td><strong>0.903</strong></td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

4.3 Calculation of Reliability:
Reliability was calculated using Cronbach reliability coefficient; the coefficient was (0.972), it’s an appropriate reliability coefficient to trust the reliability of the scale for application.

5. RESULTS
5.1 General Results:
After identifying faculty members using JUSUR by the system management at the National Center for E-learning and Distance Education, the scale has been prepared electronically and sent to them through a link via E-mail registered on the system. The completed responses were (94); (4) responses of which were excluded for not answering the items of scale validity, bringing the final total number of respondents to (90), the following table showing their distribution:

(Table 3) shows the Distribution of Faculty Research Group according to the University

<table>
<thead>
<tr>
<th>The Universities</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>King Saud University</td>
<td>40</td>
<td>44%</td>
</tr>
<tr>
<td>Umm Al Qura University</td>
<td>16</td>
<td>18%</td>
</tr>
<tr>
<td>Taibah University</td>
<td>16</td>
<td>18%</td>
</tr>
<tr>
<td>Qassim University</td>
<td>8</td>
<td>9%</td>
</tr>
<tr>
<td>Princess Nora University</td>
<td>6</td>
<td>6.5%</td>
</tr>
<tr>
<td>Jazan University</td>
<td>4</td>
<td>4.5%</td>
</tr>
<tr>
<td>Total</td>
<td>90</td>
<td>100%</td>
</tr>
</tbody>
</table>

(Table 4) shows the Distribution of Faculty Research Group according to the Colleges Classification

<table>
<thead>
<tr>
<th>The nature of the colleges</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humanities Faculties</td>
<td>40</td>
<td>45%</td>
</tr>
<tr>
<td>Science colleges</td>
<td>38</td>
<td>42%</td>
</tr>
<tr>
<td>Medical Colleges</td>
<td>12</td>
<td>13%</td>
</tr>
</tbody>
</table>

From the previous table it is clear that most participants are from the humanities faculties, followed by colleges of science and at the participants from health colleges.
5. 1. 1. The Distribution of the Research Group according to their scientific ranking is illustrated in the following table:

(Table 5) shows the Distribution of the Research Group according to scientific ranking

<table>
<thead>
<tr>
<th>Academic Rank</th>
<th>code</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor</td>
<td>1</td>
<td>14</td>
<td>15.5%</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>2</td>
<td>10</td>
<td>11.5%</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>3</td>
<td>38</td>
<td>42%</td>
</tr>
<tr>
<td>Lecturer</td>
<td>4</td>
<td>16</td>
<td>17.7%</td>
</tr>
<tr>
<td>Demonstrator</td>
<td>5</td>
<td>12</td>
<td>13.3%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>90</td>
<td>100%</td>
</tr>
</tbody>
</table>

5. 1. 2. Distribution of the research group according to gender:

(Table 6) shows the distribution of the research group according to Gender

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>Percentage</td>
<td>55%</td>
<td>45%</td>
</tr>
</tbody>
</table>

5. 2. The results of measuring attitudes of faculty members
Where the total scale items are (34), then the final score of any participant is (170) degrees. Statistical coefficients of the scale were calculated to determine the attitudes of faculty members to use JUSUR; they are shown in the following table:

Table (7) shows the Attitudes of faculty members

<table>
<thead>
<tr>
<th></th>
<th>The first axis</th>
<th>The second axis</th>
<th>The third axis</th>
<th>Attitude in general</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>61.03</td>
<td>33.48</td>
<td>48.48</td>
<td>142.98</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>8.541</td>
<td>6.131</td>
<td>11.291</td>
<td>23.563</td>
</tr>
<tr>
<td>Variance</td>
<td>72.948</td>
<td>37.589</td>
<td>127.487</td>
<td>555.204</td>
</tr>
<tr>
<td>Rang</td>
<td>29</td>
<td>22</td>
<td>43</td>
<td>94</td>
</tr>
</tbody>
</table>

The previous table shows that faculty members revealed positive attitudes towards using JUSUR in general terms as the average degree of the group in the scale represents (84.1%) of the total scores. At the axes level, questionnaire results indicated there are positive attitudes of the faculty members towards using JUSUR in the first axis, representing the highest rate (86.5%), followed by the second axis (83.7%) and finally by the third axis (81.3%)

5. 2. 1 Differences in Attitudes according to gender:

Table (8) shows the differences in attitudes according to gender

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>67.204</td>
<td>67.204</td>
<td>.919</td>
<td>.344</td>
</tr>
<tr>
<td>Within Groups</td>
<td>2777.771</td>
<td>73.099</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2844.975</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>85.204</td>
<td>85.204</td>
<td>2.345</td>
<td>.134</td>
</tr>
<tr>
<td>Within Groups</td>
<td>1380.771</td>
<td>36.336</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1465.975</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>.038</td>
<td>.038</td>
<td>.000</td>
<td>.987</td>
</tr>
<tr>
<td>Within Groups</td>
<td>4971.938</td>
<td>130.840</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4971.975</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>310.537</td>
<td>310.537</td>
<td>.553</td>
<td>.462</td>
</tr>
</tbody>
</table>

Direction as a whole
The previous table shows that there are no differences at statistical significance level (0.05) due to gender between males and females.

5. 2. 2. Differences in attitudes according to scientific ranking

Table (9) shows the differences in attitudes according to scientific ranking

<table>
<thead>
<tr>
<th>Academic Rank</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The first dimension</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>720.196</td>
<td>240.065</td>
<td>4.067</td>
<td>.014</td>
</tr>
<tr>
<td>Within Groups</td>
<td>2124.779</td>
<td>59.022</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2844.975</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The second dimension</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>548.003</td>
<td>182.668</td>
<td>7.164</td>
<td>.001</td>
</tr>
<tr>
<td>Within Groups</td>
<td>917.972</td>
<td>25.499</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1465.975</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The third dimension</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>525.352</td>
<td>175.117</td>
<td>1.418</td>
<td>.253</td>
</tr>
<tr>
<td>Within Groups</td>
<td>4446.623</td>
<td>123.517</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4971.975</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direction as a whole</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>5339.231</td>
<td>1779.744</td>
<td>3.927</td>
<td>.016</td>
</tr>
<tr>
<td>Within Groups</td>
<td>16313.744</td>
<td>453.160</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>21652.975</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The previous table indicates that there is a statistically significant differences at the level of (0.05) among faculty members due to their scientific ranking; in the first dimension for professors, associate professors and assistant professors respectively, as well as in the second dimension and in the attitudes in general.

5. 2. 3. Differences in attitudes according to College Classification

Table No. (10) illustrates the Differences in attitudes according to the college classification

<table>
<thead>
<tr>
<th>The nature of the College</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The first dimension</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>175.693</td>
<td>87.847</td>
<td>1.218</td>
<td>.308</td>
</tr>
<tr>
<td>Within Groups</td>
<td>2669.282</td>
<td>72.143</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2844.975</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The second dimension</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>88.304</td>
<td>44.152</td>
<td>1.186</td>
<td>.317</td>
</tr>
<tr>
<td>Within Groups</td>
<td>1377.671</td>
<td>37.234</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1465.975</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The third dimension</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>701.593</td>
<td>350.797</td>
<td>3.039</td>
<td>.060</td>
</tr>
<tr>
<td>Within Groups</td>
<td>4270.382</td>
<td>115.416</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4971.975</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>2404.995</td>
<td>1202.498</td>
<td>2.312</td>
<td>.113</td>
</tr>
<tr>
<td>Within Groups</td>
<td>19247.980</td>
<td>520.216</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>21652.975</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From the above table, it appears that there are no differences of statistical significance level (0.05) in the attitudes of faculty members towards using JUSUR due to the college classification, whether they are humanities, scientific or health colleges.

6. DISCUSSION
Based on the results of applying the scale, it is clear that faculty members in Saudi universities have positive attitudes towards using JUSUR, the E-learning Management System in general and in the three axes: first, the
second and the third, respectively; and that there are differences in the attitudes due to the college classification type, whether humanities, scientific and health college, where faculty members work or the nature of their work.

The results indicated the existence of statistically significant differences at the level (0.05) in the attitudes towards using JUSUR due to the scientific ranking for the category of professors, associate professors and assistant professors in their attitudes in general and in the first and second axes.

These results indicate that the faculty members using JUSUR have sufficient awareness of the importance of the E-learning and using technology in teaching; which represents a very encouraging sign for the development among faculty members in the area of using EMS. It is optimistic that the professors were the highest category having positive attitudes towards using the EMS.

These results are consistent with other studies including: (Fortune, et al., 2006); (Mooteram, 2006); (Anagnostopoulos, et al., 2005); (Joint, 2005) (Renee N. Jefferson, Liz W. Arnold, 2009) (Ozdamlı, Fezile, 2007) (Santos, Olga C.; Boticario, Jesus G., 2007); (Riad, A. & El-Ghareeb H., 2008); (Pollock, Wayne M, 2009); (Sauers & Walker,2004) that have indicated the effectiveness of using the LMS in developing the capabilities and skills of the learners as well as enriching the environment within the learning communities.

Despite these positive attitudes of faculty members, it is noted weakness of activating the system adequately; the faculty research participants have attributed this for the following reasons:

**Physical constraints:**
- Infrastructure that does not support E-learning processes within the college;
- The lack of some students to computer sets or/and internet service connection;
- The relatively high cost of Internet connection compared to some other Arab countries;
- The absence of direct technical support to both faculty members and students before and during using the system.

**Personal constraints:**
- Concerns of some faculty members and students’ families about technology;
- Community resistance to the E-learning processes considering them a sort of luxury or fun, but not learning;
- Lack of awareness regarding the bases of using the system;
- Weak awareness of the importance of the system from the side of some department heads and their refusal to activate it;
- Lack of persuasion of the faculty members regarding the E-learning and considering at as a fashion.

**Administrative constraints:**
- Lack of adequate support from the Scientific Section
- Strong resistance of some faculty members for any change or development in the academic departments, feeling threatened regarding their gained positions for the benefits of others with good knowledge of technology.

7. RECOMMENDATIONS AND PROPOSALS
In the light of results of research and proposals of faculty research group, the researcher recommends the necessity of activating the EMS in teaching, with special focus on JUSUR for its advantages, through:

- Building the culture of E-learning;
- Building learning objects and units of science and supporting research;
- Building and developing of learning objects Editing Systems;
- Developing and freeing JUSUR of the strict centralization;
- Training all faculty members and students in each semester;
- Freeing JUSUR from the extreme centralization regarding student registration and account management;
- Requiring students attended a training program on e-learning management systems;
- Developing the efficiency of the computer labs and providing students’ Internet labs;
- Allocating technical support at the same centers to resolve problems directly with students;
- Activating of incentives for faculty members for using the E-learning.
8. THE PROPOSED RESEARCH:

- Effectiveness of teaching through JUSUR in developing students’ skills and attitudes towards learning and their future professionals.
- Students’ attitudes towards JUSUR.
- Attitudes of faculty members in different universities or in all the universities within the Kingdom as a whole.

**REFERENCE**


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ACKNOWLEDGEMENTS
The Researcher expresses His deep sincere and thanks to the Deanship of Scientific Research at King Saud University for funding and supporting this research.
DETERMINATION OF PERCEPTIONS OF THE TEACHER CANDIDATES STUDYING IN THE COMPUTER AND INSTRUCTIONAL TECHNOLOGY DEPARTMENT TOWARDS HUMAN-COMPUTER INTERACTION AND RELATED BASIC CONCEPTS

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mkiyici@sakarya.edu.tr

ABSTRACT
HCI is a field which has an increasing popularity by virtue of the spread of the computers and internet and gradually contributes to the production of the user-friendlier software and hardware with the contribution of the scientists from different disciplines. Teacher candidates studying at the computer and instructional technologies department are individuals to take office in the field of instructional programs and software development. Acquaintance of teacher candidates studying at the computer and instructional technologies department with the HCI and its findings will enable such candidates to design usable websites and the achievement of message and interface design conforming to the rules. This research was conducted by using the phenomenological research method in order to determine the descriptions and perceptions of teacher candidates studying at the computer and instructional technologies department in respect of the human-computer interaction and respective basic concepts. Data gathered from the candidates by means of an open-ended question form were analyzed using descriptive analysis. According to the research results, it was seen that teacher candidates described the human-computer interaction and related basic concepts approximately close to the truth.

KEYWORDS: Human-computer interaction, teacher candidate, CEIT, perception

INTRODUCTION
Contemporary society is increasingly reliant on interactive computer systems (Curzon, Ruksenas & Blandford; 2007). Computer systems is a comprehensive concept involving bank ATMs, mobile phones, electronic appliances such as television and fridges used in our houses. Individuals send some commands to the electronic appliances via buttons thereon, and the appliances perform works and operations pre-designated according to such commands received. As a result of the rapid development of the information and communication technology, the use of computers in education has become inevitable (Serin, 2011). Electronic appliances used in our houses are microcomputer applications and limited with the operations and tasks they can achieve. Computer systems we use are enabled to perform different operations and tasks by the help of programs installed. When observing communication between humans, we can see that a lot of information is only exchanged implicitly (Schmidt; 2000). People either transmit the messages explicitly or give some implicit messages in the communications set between them. However, when the subject is related with the human computer interaction (HCI); individuals should give clear and certain messages. Current computer technology interaction is explicit - the user tells the computer in a certain level of abstraction what s/he expects the computer to do (Schmidt; 2000). If missing or indefinite data is sent, functions and procedures will not work or will work undetermined, for computer programs run through functions and procedures.

HCI is a specialization of the more general field of ergonomics because HCI deals with a particular set of tools, computers (Diaper & Sanger; 2006). HCI and ergonomics are sciences which are mostly confused and compared. Whereas ergonomics aims practical production of appropriate tools and technologies for the human health, HCI studies more functional designs of computer software. Hewett et al. (1992) defined HCI as “a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them” (Zhang & Li; 2004). As understood from the definition, HCI is concerned with the designs and implementations as well as the evaluation of the interface designed. HCI is not only a field which is required to be engaged by the scientists producing and evaluating computer hardware and software. HCI is a major interdisciplinary conjunction of several sciences and technologies (Shackel; 2009). The interdisciplinary area of human-computer interaction emerged as a partnership among researchers from computer science, business administration, psychology, communication, educational technology, and librarianship (Fidel; 1987). For being an effective and productive utilization of the computer software and hardware by humans, HCI research field is affected by studies of the scientists dealing with the instructional technology and computer science, scientists analyzing the differences caused by the designs on humans in the field of physiology and the scientists engaging in the production of accurate messages and accuracy of the messages perceived by the individuals in the field of communication. Usable websites enable the user to get the most efficiency from the websites by increasing the level of userwebsite interaction (İşman & İşbulan, 2010). It is essential to evaluate the computer software free from person targeted, the development
process, computer system he used and context in which it is used. The HCI field defines four main dimensions, which take part in interactions: CIS characteristics, user characteristics, development process, and context of use (Despont-Gros, Mueller & Lovis; 2005). HCI conducts evaluations take the four main fields designated and differences in these fields into consideration while analyzing software and hardware. Human-Computer-Interaction (HCI) is the area where usability is planted (Akıllı, 2005).

Computers have been called universal machines, machines that can execute an indefinite amount of different functions, and that can therefore function as very different tools for us at different times (Brey; 2005). While computer is a must for the occupation of some individuals living in today’s community, it is an entertainment tool for some of them. Today, business men perform most of their daily works using computer and Internet and students realize their educational lives over internet and computer. The way people interact with devices is vital for their success (Schmidt; 2000). The interaction process of humans with computers by giving commands, clicking icons, pushing buttons or using appropriate input units is important for the tools to fulfill their tasks and thereby for humans to benefit from such interaction process. For example, a computer user who does not know exactly the functions of the icons on the screen of word processor programs may not save the file even if he writes the text as desired. Computer users have contact with an information system only with the help of an interface that defines information flow rules between a human and a machine (Michalski, Grobelny & Karwowski; 2006). Today’s contemporary computer operating systems and utility programs base all their functions and commands on the principle of clicking icons and visuals. Meanwhile, in contemporary IT systems, users most frequently exchange information with the application by pointing various graphical elements and by confirming (usually by clicking) the execution of a given activity (Michalski, Grobelny & Karwowski; 2006). The advantage of graphical user interfaces over the older symbol-based interfaces (such as DOS and UNIX) is that they rely on our sensorimotor abilities to orient ourselves in space and to recognize and manipulate objects (Brey; 2005). In command-based operating systems, humans needed to write some commands and all parameters thereof in a complete manner in order to communicate with computers. In graphics-based operating systems humans communicate with computers by the help of the scripts which are installed with certain functions and tasks and transformed into icons and buttons. HCI engages in design of icons and buttons, design of content and design of message.

The real beginnings of HCI as an emerging discipline are more like 25 years ago, with the founding of early conferences: Interact, CHI, British HCI and Vienna HCI (Dix, 2010). Studies performed before that date are generally evaluated within the field of ergonomics and they generally focus on the hardware and environment units rather than the screen design. HCI emerged after humans started to use graphic interfaces as a result of introduction and expansion thereof. In the earliest days of HCI, the contribution from human factors researchers took the form of guidelines, which summarized known findings that could be applied to the development and evaluation of computer interfaces (Boehm-Davis; 2008). The evolution of human–computer interaction design (HCID) over the last 20 years suggests that there is a growing need for educational scholars to consider new and more applicable theoretical models of interactive product design (Faiola & Mater; 2010). Finding of HCI field are taken into consideration in the production and design of both software and hardware of new interactive tools and new tools are developed as per such rules. Mice used in recent years can be cited as an example in this regard. Whereas old model mice comprise of only 2 buttons and a roller enabling the mouse to move, new mice are produced with a wheel enabling to scroll up and down on internet browsers Human–computer interaction is a rapidly evolving discipline (Santos; 2006). As human–computer interaction (HCI) and interactive systems design have developed a sense of people living with and through technologies, our concerns have broadened from usability to include wider qualities of people’s experiences with technology (McCarthy et al; 2006). Humans access to the information they search through the software and hardware developed by the help of the HCI findings and transmit the messages to the computers more easily.

Modern information technology now affords organizations, businesses, individuals, and institutions of learning a variety of options for engaging in communication and information exchange (Burgoon and et all, 2000). Computer technology is involved in many aspects of our daily lives (İşman & Çelikli, 2009). With the proliferation of desktop computers, it was discovered that non-technical users were not satisfied with the same type of environment that programmers used (Gerlach & Kuo ;1991). Inexperienced users started to use computer and Internet upon the expansion of the use of computer and Internet and the expansion of the services of institutions and organization over Internet, as well as the users experienced in the field of computers. One of the main objectives of HCI is to insure users inexperienced in using computers to use computers problem-free. The human–computer interface (HCI) problem under consideration is the location and sequencing of the menu items and icons that assist the person with maximizing efficiency of the computer as a tool (Peer & Sharma; 2008). Images, menu and content elements available on the interface should be placed rationally for the users inexperienced in graphic interface to be at ease and to use the same easily. Placement of the menu items
organizing interface and content is significant particularly for interactions of the inexperienced users. The objective of the user interface components layout problem is to locate the menu/icon items on the screen/keyboard/mouse in order to achieve the greatest efficiency in exchanging the inputs and outputs between the user and the system (Peer & Sharma; 2008). Interface designers ought to be concerned with facilitating clear and accurate information exchanges, efficient transactions, and high-quality collaborative work (Burgoon and et all, 2000). Interfaces are complex, cybernetic-like systems that can be built quickly but are difficult to build well (Gerlach & Kuo ;1991). More importantly there is a lack of guidance in applying HCI research findings to design practice. Consider a typical interface design based upon many decisions: which functions and objects to include; how they are to be labeled and displayed; whether the interface should use command language, menus, or icons; and how online help can be provided (Gerlach & Kuo; 1991).

**PURPOSE**

Main purpose of this research is to reveal teacher candidates’ perceptions towards human-computer interaction and related basic concepts.

**METHOD**

Phenomenological research, one of the qualitative research models, was selected as the research method for this research. Phenomenological research is a method aiming to determine people’s opinions and views about any phenomenon that they experience and their individual experiences. Daymon and Holloway (2002, 153) characterized phenomenological research as below;

- Researchers consciously suspend, or bracket, their own assumptions so they can see through the eyes of participants,
- Sample sizes are usually small,
- In phenomenological research, you try to make sense of a phenomenon according to participants’ own terms, identifying the essence or ‘real’ meaning of the phenomenon under investigation.

In phenomenology, foundational question is “What is the meaning, structure and essence of the existing experience of this phenomenon for this person or group of people” (Patton, 1990). Phenomology as a method looks at the lived experiences of those who have experienced a certain phenomenon (Lichtman, 2006). Todres (2005) described phenomenological research through the following components:

- The researcher gathers detailed concrete descriptions of specific experience from others,
- The researcher adopts the attitude of the phenomenological reduction in order to intuit the intelligibility of what is given in the experience,
- The researcher seeks the most invariant meanings for a context.

**WORKING GROUP**

Purposeful sampling was used for the determination of the participants comprising the working group. Purposeful sampling refers to study with the cases meeting the measures determined previously in the research (Yıldırım and Şimşek, 2006). Researcher designates participants having the most proper and desired characteristics for the research as sample with his own judgment in such sampling (Balcı, 2004). In this research, 51 teacher candidates who study in Sakarya University, Educational Faculty, Computer and Instructional Technologies Education in 2009-2010 educational year and are enrolled in the course of “Human-Computer Interaction” were selected as the research participant using purposeful sampling.

**DATA COLLECTION**

The literature was reviewed for the purpose of data collection and basic concepts were determined related to human-computer interaction. A measuring tool including 6 concepts designated by the researcher was developed. In the measuring tool developed, teacher candidates were given concepts and requested to describe them. A session was organized and thereby it was provided that the teacher candidates make respective descriptions. Data that were gathered after the teacher candidates described the concepts covered by the measuring tool were computerized and themed.

**FINDINGS AND INTERPRETATION**

This section covers the findings within the framework of the human-computer interaction key concepts posed to the teacher candidates and requested to be described by the teacher candidates within the scope of this research. In the research, teacher candidates were initially asked to describe the concept of usability. Themes derived from the usability descriptions of the teacher candidates are provided in Table 1.
Table 1 Themes derived from the usability descriptions of the participating teacher candidates

<table>
<thead>
<tr>
<th>Theme</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfaction</td>
<td>37</td>
</tr>
<tr>
<td>Effectiveness</td>
<td>18</td>
</tr>
<tr>
<td>Efficiency</td>
<td>13</td>
</tr>
</tbody>
</table>

Themes derived from the participating teacher candidates’ descriptions related to the usability concept were designated as **satisfaction, effectiveness** and **efficiency**.

When the descriptions of the teacher candidates about the usability were analyzed, descriptions focusing on the relationship of the user with web site or program, use of the web site or program with ease by the user or the satisfaction of the user from the visual design of the web site or program were gathered under the theme of satisfaction. The direct quotations from the descriptions written by the teacher candidates are as follows;

“...means providing ease of use. Namely, it means whether the web site is fast or provides ease of use, in other words, scroll bars may be sometimes vertical and it makes the use difficult.”

“It is a concept addressing to the user with its ease of use and simplicity.”

“It means a service degree of the web sites prepared by us for the users…”

“...all of the things appeared as a result of the layout providing us to access more easily to what we search in the programs or websites, colors and sizes to be more easily used and technical substructure ensuring to do faster transactions.”

Although the usability concept includes concepts and phenomenon such as technical substructure of the web site and information organization; teacher candidates generally centered on the satisfaction of the user from the website and program, navigation in the website with ease (placement of familiar icons in the website and program etc.) and easy access to the information and section searched.

Following the satisfaction theme, theme of effectiveness was derived from the usability descriptions of the teacher candidates. The themes evaluated under the effectiveness being one of the usability descriptions provided by the teacher candidates are generally the descriptions related to the inclusion of information fitting the purpose of service in the website, exclusion of the irrelevant, direction to the contents with the help of proper icons and content tables and access to the content without branching out. The quotations from the descriptions provided by the teacher candidates are as follows;

“...shows how successful the web site is. In other words, it is the achievement of the user in accessing to the information searched”

“It means that the user performs his transactions in a shorter time and more effectively…”

“...means that the user access to the content in a fast, easy and comfortable manner. It refers to the fact that the user finds what he searches in the website without losing his rotation...”

“...user should access to any information searched without facing any difficulty or waiting problems and isolatedly from any item distracting him.

The theme of efficiency was derived after analyzing the usability descriptions of the teacher candidates. Efficiency theme includes several concepts such as website and program enabling the user to navigate in the website without any difficulty in accessing to any content without spending too much time, and the access cost of the site and contents being low. The direct quotations from the usability descriptions provided by the teacher candidates are as follows.

“...means that the user performs any desired act in the simplest and merest manner”

“...means that the user satisfies his needs optimally and as soon as possible in terms of time and cost...”

“...in terms that user navigates and does not get lost in the website...”

When the themes derived from the usability concept descriptions of the teacher candidates and the direct quotations from the descriptions of the teacher candidates are analyzed, it can be deduced that websites that can be considered as usable are the websites satisfying the users with its interface, ensuring the users to visit the website repeatedly, providing the user with the researched information without navigating too much and the websites in which the users are well guided while navigating.
Within the scope of the research, the second concept which teacher candidates were asked to describe is the concept of message. Themes derived from the message concept descriptions of the teacher candidates are provided in Table 2. Two themes derived from the message concept descriptions of the teacher candidates were determined as contents and alerts.

<table>
<thead>
<tr>
<th>Theme</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contents</td>
<td>27</td>
</tr>
<tr>
<td>Alerts</td>
<td>23</td>
</tr>
</tbody>
</table>

When the message descriptions of the teacher candidates were analyzed, the descriptions centering upon opinions and views transferred to the users within the scope of the website or program, contents transferred to the users were gathered under the theme of contents. 27 descriptions of the descriptions written by the teacher candidates were evaluated under the theme of contents. The direct excerpts from the descriptions written by the teacher candidates are as follows;

“…In practice, it refers to the theme and thought we desire to transmit”
“We can define as the content we desire to transmit to the target audience”
“It means the information which attracts us in the course of accessing to the website and is inserted into the website”
“It is the information desired to be given by a website”

23 descriptions of the message descriptions of the teacher candidates were collected under the theme of alerts. Teacher candidates defined the messages evaluated under the alerts theme as the user directions available in the website or program, feedbacks given to the users in case of error occurrence in the website or program.

“Directing the user through an alert such as "You made an invalid request" when he made a request which is not available in the website…”
“Feedbacks given by the application or website about the things to do and not to do, feedbacks and alerts received by the user from various web-pages”
“The user who made a mistake in the web-page can be informed with a message and assisted to take proper actions.”
“It means that feedbacks given in order to inform the user after the bad or incorrect processes performed by the user in a website”

When the message concept descriptions of the teacher candidates and themes derived from such descriptions are analyzed, it is seen that there are teacher candidates defining the message concept as the content introduced by a website as well as teacher candidates defining the same as the direction and error messages.

In the research, another concept which teacher candidates was asked to describe is design. Themes derived from the design concept descriptions of the teacher candidates are provided in Table 3. Themes derived from the descriptions were determined as interface and contents.

<table>
<thead>
<tr>
<th>Theme</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>49</td>
</tr>
<tr>
<td>Contents</td>
<td>16</td>
</tr>
</tbody>
</table>

49 descriptions of the design concept descriptions provided by the teacher candidates were collected under the interface theme. The fact that descriptions of the teacher candidates include concepts such as web site interface, page layout, visual items enabled the definitions to be evaluated under this theme. The direct quotations from the descriptions of the teacher candidates are provided below.

“…it means that interface of a website is designed properly to meet the expectations of the user.”
“…to prepare the website after establishing the details where the title and content will be inserted, to which parts of the page the content and menu will be placed…”
“…it a part of the program we use which will communicate and interact with the user visually.”
“Placing the page, fonts, images, flash and animations etc. properly into the website…”

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16 descriptions of the design concept descriptions provided by the teacher candidates were collected under the contents theme. Teacher candidates stated that the design interface covered the interface design as well as contents introduced by the website and program and it was necessary to carry out contents design at the beginning stage of the website or program designing. The quotations from the descriptions provided by the teacher candidates are as follows;

“...it means an effective presentation of contents prepared in any field…”
“...it means determining the target audience and where, which and how information will be introduced…”
“...related to decreasing unnecessary information and complexity, and increasing user satisfaction…”

When the design descriptions of the teacher candidates are examined, it is seen that teacher candidates’ perceptions towards design is collected under two dimensions including interface and contents. Teacher candidates stated that it is necessary to introduce information in an organized manner by designing both interface addressing to the users as well as contents introduced by the website and program so that users use the websites and programs with ease.

Themes regarding the teacher candidates’ interaction descriptions are provided in Table 4. As seen in the Table 4, whereas 41 descriptions of teacher candidates describe the interaction concept as a phenomenon between human and computer, 32 of them evaluated it as a phenomenon between human and human. In 26 descriptions, teacher candidates stated that interaction was a phenomenon among the computers.

<table>
<thead>
<tr>
<th>Theme</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human - Computer</td>
<td>41</td>
</tr>
<tr>
<td>Human - Human</td>
<td>32</td>
</tr>
<tr>
<td>Computer - Computer</td>
<td>26</td>
</tr>
</tbody>
</table>

Teacher candidates described that the interaction occurred between human and computer; humans make an effect on the icons and writings available on the computer screen in the course of using computer; and computer perform a process as a result of such effect. Teacher candidates expressed that interaction phenomenon includes the processes that individuals fill forms available on the screen and cross specific parts of the images; and the contents on the web site create a change in the minds of the users. The quotations from the descriptions provided by the teacher candidates are as follows;

“...it is a concept that we can describe as a transmission of messages between user and computer through design, content and tools…”
“...It means that user can use an application through forms, images and texts and receive feedbacks. ...”
“...Interaction of people with computers using some external hardware accessories and appropriate programs...”
“...interacts with user introducing a web page designed...”

Another theme derived from the acceptability descriptions written by the teacher candidates is human – human interaction. Under this theme, teacher candidates stated in their views collected that interaction occurred between a human and another human. They described the interaction concept as the conversations between the individuals and get being affected by from their gestures and facial expressions mutually. The quotations from the descriptions provided by the teacher candidates are as follows;

“We can describe it as the conversations between people, involving in activities and sharing…”
“Communication between two people, and getting influenced from each other…”
“...it means that individuals attach importance to the personal problems and views of the others and act accordingly…”

There are some teacher candidates stating that interaction occurred between humans and other humans, and humans and computers while others stating that interaction occurred between a computer and another computer. Some of the teacher candidates describe the information exchange through computer, Internet as interaction process. The quotations from the descriptions provided by the teacher candidates are as follows;

“...Interactions between two objects…”
“...means that two different components in a relationship come to an agreement and set a communication easily between each other.

"... Namely existence of a continuous relationship between two things...”

In the research, another concept which teacher candidates were asked to describe is human-computer interaction. Themes derived from the descriptions written by the teacher candidates are determined as software and hardware.

Table 5 Themes derived from the human-computer interaction descriptions of the participating teacher candidates

<table>
<thead>
<tr>
<th>Theme</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software</td>
<td>43</td>
</tr>
<tr>
<td>Hardware</td>
<td>33</td>
</tr>
</tbody>
</table>

Descriptions focusing on the software provided by the teacher candidates in respect of the human-computer interaction concept were evaluated under the theme of software. In their descriptions of interaction, teacher candidates state that interfaces of programs and websites provide the human-computer interaction; and individuals interact with the computer by means of the objects available in the interface and access to the information they search. The quotations from the descriptions provided by the teacher candidates are as follows;

“...means that users use an application more easily with the help of a good interface...”

“...a reaction given to us by a program or webpage operating in the computer...”

“...Any software that is commonly used by all the people facilitates the human and computer interaction...”

“...it means how the programs we use in computers affect us and how they direct us...”

When the human-computer interaction descriptions provided by the teacher candidates were analyzed, descriptions giving weight on software as well as hardware were evaluated hereunder. Teacher candidates expressed that they needed environment units and hardware so that programs, software besides individuals interacted with the computer. The direct quotations from the descriptions of the teacher candidates are provided below.

“...accordance with hardware or software during the use of computer in order to perform the task of...”

“...it means that people use the computer in line with their demands using some external hardware accessories and programs...”

“...a field researching how to make better the ergonomics and usability in design...”

“...two-way communication of user, environment, hardware and software...”

Within the scope of the research, the last concept which teacher candidates were asked to describe is the concept of interface. When the interface descriptions are analyzed, it is seen that all the teacher candidates describe the concepts of interface in a similar way. Teacher candidates define this concept as the visible part of where the transactions are performed by the users; as an interface that is eliminated from the code complexity of the program and website and formed with fonts, images, graphics and icons so that the individuals who do not understand the stacks of computer codes carry out their works and operations. The quotations from the descriptions provided by the teacher candidates are as follows;

“The visible part of which users interact while carrying out their processes...”

“...the interface ensuring the user to interact with the medium he needs... It can be a website. Or a program...”

“...It is the visible pages of the applications and websites. All the elements visible on a webpage compose the user interface. Interfaces should attract users’ interest...”

“...It is a visual design element enabling user to use the application he uses in fast and active manner.

“...it is a visual part of a website. “Background color, fonts, links, buttons, forms etc. of the web site, these are available on the user interface. ...”

“The user interface is all of the designs such as menus, images, background, and user language on homepage.”

CONCLUSIONS AND SUGGESTIONS

The research findings reveal that teacher candidates generally describe the concept of usability as the items ensuring the satisfaction of the user. It is necessary to teach teacher candidates trained as a web designer in the courses to be delivered that usability concept will not only be achieved by ensuring satisfaction of the user but also fast access to the information searched and introduction of accurate information in websites will increase the acceptability. When the message concept descriptions of teacher candidates are analyzed, the teacher candidates
mention both contents and alerts and define the message concept comprehensively. The teacher candidates mostly mention interface design but not content design when the design concept is asked in the field of HCI. When the teacher candidates are asked to define the human computer interaction, it is determined that they largely attach importance to the software concept and less importance to the hardware concept due to the concept of software. Within the scope of the research, the last concept which teacher candidates were asked to describe is the concept of interface. Teacher candidates describe the concept of interface as the screens ensuring the human – computer interaction.

When the teacher candidates’ descriptions regarding human-computer interaction and respective basic concepts are analyzed, it was determined that they generally made descriptions conforming to the literature. (Gerlach & Kuo; 1991, Boehm-Davis; 2008, Zhang & Li; 2004). Software developed by the teacher candidates within the scope of the courses can be tested and message design, interface design and usability can be reviewed by various user audiences; and teacher candidates can be assisted to adjust their design by giving feedbacks in order to enhance the experiences of the teacher candidates in the field of HCI.

REFERENCES


DEVELOPING AND VALIDATING A MEDIA LITERACY SELF-EVALUATION SCALE (MLSS) FOR ELEMENTARY SCHOOL STUDENTS

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ABSTRACT  
The arrival of new media technology has the potential to radically change education. It has become important for both academics and practitioners to understand the behavioural intentions of students towards media technology. Many scales have been developed to measure the attitudes of secondary students towards the usage of media technology. However, few scales have been developed to assess media literacy in primary school students. To develop a validated scale for the media literacy of elementary school students, the Media Literacy Self-assessment Scale (MLSS) was adopted and modified in this study and then validated using a sample (N=594) of students from Taiwan. The MLSS is a two-factor scale that measures learning with media (LWM) and media communication & ethics (MCE); these components have been proposed to constitute the multidimensional constructs. A confirmatory factor analysis was performed on a proposed nine-item model of the MLSS, and it was found the model provides a good fit. Gender and grade comparisons of the results are discussed. Educational implications and suggestions for future research are also provided.  
Keywords: Media Literacy Self-assessment Scale (MLSS), Scale Validation, Confirmatory Factor Analysis, Taiwanese Elementary School Students

INTRODUCTION  
The influence of media technology on the social environment is ubiquitous. In today's world, media has become a way of life. The media informs us, entertains us, and connects us to the world. Recently, new technology has emerged (such as edutainment technology) and been applied in different fields (Chang, Lee, Wang, & Chen, 2010; Cheng, Wu, Liao, & Chan, 2009; Chiang, Lin, Cheng, & Liu, 2011; Lee & Chen, 2009; Lin & Liu, 2009;
Media surrounds us and is present in everything. This phenomenon has made learning easier and more interesting for children. Television, radio, computers and the Internet are gradually entering classrooms and changing the way that students learn. In particular, computers and the Internet are quickly becoming our dominant cultural tools for searching, selecting, gathering, storing, and conveying knowledge in representational forms (Covington, 2004; Jenkins, 2006; Kuiper, Volman, & Terwel, 2009). There are both advantages and disadvantages to increasing one's knowledge of the different aspects of media. As we adopt the good components of this knowledge, we should also try to avoid the bad. The negative messages disseminating through various media technologies can be avoided by developing the skills to question, evaluate and analyse these messages. Therefore, it is vital for individuals to develop media literacy so that they can make the best use of the new technology and so that they are able to interpret and process all kinds of media messages (American Library Association, 1989; Enochsson, 2005; Thoman, 2003).

Media literacy can be broadly defined as a combination of the various skills needed to search, select, analyse, evaluate, and communicate in the various forms of media (Considine, Horton, & Moorman, 2009; Enochsson, 2005; Livingston, 2004; Kuiper, Volman, & Terwel, 2009). Kuiper, Volman and Terwel (2009) identified the principal components of three forms of media literacy related to the World Wide Web: Web searching skills, Web reading skills, and Web evaluation skills. Similarly, Covington (2004) advocates the notion that media literacy involves critical viewing skills and the ability to regard, evaluate, and interpret content. Furthermore, Schaefer (2005) pointed out that media literacy is usually conceptualised as a set of skills related to the production of a media message. In sum, media literacy has been identified as an essential form of literacy by the Partnership for 21st Century Skills, and it is crucial that schools focus on helping students acquire the skills necessary to navigate, evaluate, and communicate in various kinds of media (Jenkins, 2006).

Media literacy does not simply encompass being entertained by the media; it also necessitates that one learns something from it. Furthermore, the subjects that we learn in our curricula are also found in the media. These subjects may include the arts, science, maths, different languages, social sciences and health. Media literacy may also help to develop critical thinking skills. The students are able to get a broad exposure to popular cultural references. They can gather statistics and data from the news that can then be the basis for math and science learning. Because a major part of the learning process is concentrated on children, the new media can play a significant role in satisfying their intellectual curiosity. Children often learn important things through the media, which can change their perspective on life. Teachers can also incorporate media analysis whenever the Internet, computers, television or video is used in the classroom.

Scholars have begun to conduct research that focuses on learning in media literacy education and, in particular, on the relationships between students’ existing knowledge about the media and the knowledge teachers make available. Brag (2002) used her classroom observation to illustrate that what students learn and how they learn it during media literacy practice often has little relevance to their everyday media use. Caronia (2009) used conversation analysis to identify a typology of the interactions between children while they watched television in an educational context. These scholars stress the need to gather ethnographic data on the actual media experiences of students and how they perceive media literacy strategies. Erstad and Gilje (2008) explored the impact of everyday experiences with media and digital tools on the production practices of students in media education. Their survey data indicate that young people largely draw on their media experiences from outside school. Therefore, media literacy education should address the intersection between formal and informal ways of learning among youth.

Although media has been around for a long time, many administrators and teachers have just begun to hear about media literacy and to realise its importance. Because media literacy education is essential for modern citizens and is an important quality in civic society, it should begin at the earliest possible stage (i.e., during elementary...
To equip students with the required skills, three general guidelines exist for teaching basic media literacy in K-12 (Utah State Office of Education, 2006) which are (1) Awareness: students will be aware that media literacy as a life skill is integral to modern citizenship, informed decision making, and healthy lifestyles. (2) Analysis: students will analyze elements of media messages to understand their forms and functions, content, and effects on the receiver. (3) Evaluation: students will evaluate elements and intended results of media messages to facilitate selection for personal and educational use. Chang and Liu (in press) also proposed three components of media literacy for elementary school students: (1) media application skills (students’ abilities to perform media technologies), attitudes toward media (students’ perceptions regarding ethics of technologies), and (3) learning with media (students’ abilities to extract messages from media to perform learning tasks). Based on the review of the existing literature, there is no widely accepted instrument to assess media literacy in Taiwanese elementary school students. Therefore, the purpose of this study is to develop and validate a Media Literacy Self-assessment Scale (MLSS) for assessing the media literacy of elementary school students. According to Chang and Liu’s (in press) study, media application skills and attitudes toward media are categorized as a combined dimension “media communication & ethics”. Therefore, learning with media (LWM) and media communication & ethics (MCE) will be included in the developed instrument to measure students’ perceptions towards media literacy. Furthermore, after validating the questionnaire, grade and gender differences were analysed.

**DEVELOPMENT AND VALIDATION OF MLSS**

**Pilot Study**

**Participants**

A total of 300 subjects participated in the pilot study. Subjects were recruited from five elementary schools in Taipei, Taiwan. Among the participants, 149 were female students and 151 were male students. There were 146 5th graders and 154 6th graders among the group.

**Reliability and Validity of the MLSS**

A pool of items was adapted from the Media Literacy Self-assessment Scale (MLSS), which was developed by Chang and Liu (in press). A total of 13 items were selected to assess each subject’s cognitive response towards using media technology in learning and their behavioural attitude towards using media technology. All items were scored on a 5-point Likert scale that ranged from “strongly disagree” to “strongly agree”.

The revised 13-item MLSS (See Appendix A) was given in a pilot study to 300 students who were aged 12-13. The sample was 49.7% female (n=149) and was drawn from 10 classes in 2 primary schools in Taipei, Taiwan. Each survey was administered by the same person; the MLSS can be administered in 10 min. Participants were advised that the scale is not a test and that there are no right or wrong answers. They were asked to indicate the level of their agreement with each statement and to answer as honestly as possible. Data was analysed using SPSS 12.0 to assess the reliability and validity of the measure.

To explore the factorial structure of MLSS, we conducted exploratory factor analysis (EFA) on sample 1 (N=300) using principal axis factoring and varimax rotation (Table 1). Most researchers recommend a sample size of 100-200 cases for exploratory factor analysis (Hair, Black, Babin, Anderson, & Tatham, 2006). As such, the sample of 300 cases is more than adequate at this stage of analysis.

The overall alpha coefficient for the 13 items of MLSS was 0.9, and the coefficients for media application skills and the media communication and ethics subscales were 0.83 and 0.72, respectively. These coefficients are regarded as being acceptable for scale construction (DeVellis, 2003). To choose the number of factors, eigenvalues greater than 1 and the screen test were used as the decision criteria. There were two factors that had eigenvalues greater than 1; these factors accounted for 49.34% and 8.27% of the variance. An item was retained only when it loaded greater than 0.50 on the relevant factor and less than 0.50 on the non-relevant factors. All of the factor loadings in each factor were greater than 0.50. The first factor consisted of 6 items (m_1_b, m_2_a, m_2_b, m_1_a, m_2_d, and m_2_c with factor loadings of 0.744, 0.693, 0.679, 0.666, 0.576, and 0.513, respectively) out of the 13 MLSS items. This factor was named learning with media (the variance of this factor explained 49.34% of the total variance). The second factor consisted of 7 items (m_4_b, m_4_a, m_4_c, m_3_a, m_3_b, m_1_c, and m_3_c with factor loadings of 0.763, 0.599, 0.576, 0.544, 0.533, 0.528, and 0.522, respectively) of the MLSS; this factor was named media communication and ethics (the variance explained 8.27% of the total variance).
Table 1: Results of Exploratory Factor Analysis

<table>
<thead>
<tr>
<th>Items</th>
<th>LWM</th>
<th>MCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>m_1_b</td>
<td>.744</td>
<td>.286</td>
</tr>
<tr>
<td>m_2_a</td>
<td>.693</td>
<td>.363</td>
</tr>
<tr>
<td>m_2_b</td>
<td>.679</td>
<td>.272</td>
</tr>
<tr>
<td>m_1_a</td>
<td>.666</td>
<td>.328</td>
</tr>
<tr>
<td>m_2_d</td>
<td>.576</td>
<td>.300</td>
</tr>
<tr>
<td>m_2_c</td>
<td>.513</td>
<td>.453</td>
</tr>
<tr>
<td>m_4_b</td>
<td>.228</td>
<td>.763</td>
</tr>
<tr>
<td>m_4_a</td>
<td>.387</td>
<td>.599</td>
</tr>
<tr>
<td>m_4_c</td>
<td>.204</td>
<td>.576</td>
</tr>
<tr>
<td>m_3_a</td>
<td>.442</td>
<td>.544</td>
</tr>
<tr>
<td>m_3_b</td>
<td>.423</td>
<td>.533</td>
</tr>
<tr>
<td>m_1_c</td>
<td>.418</td>
<td>.528</td>
</tr>
<tr>
<td>m_3_c</td>
<td>.329</td>
<td>.522</td>
</tr>
<tr>
<td>Cronbach’s α</td>
<td>.83</td>
<td>.72</td>
</tr>
<tr>
<td>Eigenvalues</td>
<td>6.41</td>
<td>1.07</td>
</tr>
<tr>
<td>Cumulative of variance (%)</td>
<td>49.34%</td>
<td>57.61%</td>
</tr>
</tbody>
</table>

Note: LWM: learning with media; MCE: media communication and ethics

Primary Study

Student Sample

The participants in this study were elementary school students in Taiwan (5th and 6th graders), whose ages ranged from 12 to 13 years old. Over a 5-week data collection period, 900 paper-based questionnaires were distributed among three major demographic areas in northern, central, and southern Taiwan. From each area, a varied number of individual classes from several elementary schools were chosen to complete a survey.

The non-responses, unintentional skips or unidentifiable marks on some items of the survey were processed by the study as “missing data”. Hence, the valid number of samples for each item or subscale of the survey varies. However, the “missing data” does not exceed 5% of the whole data set for any one item or subscale. A total of 594 usable questionnaires were returned, yielding an effective rate of 66%. Among the respondents, 301 were males and 293 were females; 259 were 5th graders and 335 were 6th graders.

Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis was conducted to test a two-factor model of the MLSS, as revealed in the pilot study. It was hypothesised that confirmatory factor analysis of the MLSS would indicate that the responses to the MLSS could be explained by two factors, identified as Learning With Media (LWM) and Media Communication & Ethics (MCE). We used Lisrel8.8 with a maximum likelihood method to test our factorial validity.

We used sample 2 (N=300, randomly selected from the 594 participants) to develop a model. A variety of fit indices were used to test the model fit. An adequate model fit is represented by GFI, CFI, and NNFI values that are greater than 0.90 (Hoyle & Panter, 1995) and a RMSEA value below 0.05 (Byrne, 2001). Based on the EFA, a two-factor model result did not offer a good fit ($\chi^2=307.57$; GFI=0.86; CFI=0.95; NNFI=0.94; SRMR=0.058; RMSEA=0.11). Next, we removed some items to improve the model fit according to the modification index. The modification index was computed using residual values. On the basis of this criterion, we deleted items from the larger MI in the CFA model. Items m-1a, m-2d, m-3b, and m-4b were removed and the fit indices (which shifted to $\chi^2=54.34$; GFI=0.96; CFI=0.99; NNFI=0.98; SRMR=0.037; RMSEA=0.06) fit the data well.

In this study, we employed sample 3 (N=294, selected from the 594 participants after removing the 300 participants used in sample 2) to further demonstrate a two-factor CFA model. After deleting 4 items of the MLSS in sample 2, a two-factor CFA model was also reliable. The results showed a satisfactory fit to the data ($\chi^2=63.52$; GFI=0.95; CFI=0.98; NNFI=0.97; SRMR=0.038; RMSEA=0.07). These results indicated that our two-factor model had a good fit to the other sample set.

We next used a competitive model approach to determine the model that best fit the theory. Following that, the convergent validity, discriminate validity, composite reliability and item reliability will be shown below.

Model Competition

In this stage, in addition to our hypothesis model (first-order, two-factor oblique model), we used an independent model and a first-order, two-factor orthogonal model as alternative models. Table 2 presents the independent
model that had the worst fit indices. Compared to the independent model, the first-order, two-factor oblique model and the first-order, two-factor orthogonal models are significant improvements. Specifically, the first-order, two-factor oblique model exhibits the best fit to the data. Because the high-order models did not converge, this result indicates that the first-order, two-factor oblique model fits the data best.

<table>
<thead>
<tr>
<th>Fit indices</th>
<th>$\chi^2$ (df)</th>
<th>$\chi^2$/df</th>
<th>RMSEA</th>
<th>GFI</th>
<th>AGFI</th>
<th>CFI</th>
<th>NNFI</th>
<th>SRMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent model</td>
<td>1974.02(36)</td>
<td>54.83</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-order, two-factor orthogonal model</td>
<td>198.65(27)</td>
<td>7.35</td>
<td>.15</td>
<td>.87</td>
<td>78</td>
<td>88</td>
<td>85</td>
<td>.27</td>
</tr>
<tr>
<td>First-order, two-factor oblique model</td>
<td>63.52(26)</td>
<td>2.44</td>
<td>.070</td>
<td>.95</td>
<td>.92</td>
<td>.98</td>
<td>.97</td>
<td>.038</td>
</tr>
</tbody>
</table>

In a second stage, we further compared the independent model to the one-factor model and the two-factor model (Table 3). Specifically, the one-factor model allowed all of the items of the MLSS to load on one factor. The two-factor model with the items assigned to the two corresponding variables. Results showed that the two-factor model yielded a better fit ($\chi^2=129.99$, $p<0.001$, $df=98$, $\chi^2$/df=1.32, RMSEA=0.047, GFI=0.90, CFI=0.95, NNFI=0.93, SRMR=0.07), and the $\Delta \chi^2$ was also significant.

<table>
<thead>
<tr>
<th>Fit indices</th>
<th>$\chi^2$ (df)</th>
<th>$\chi^2$/df</th>
<th>$\Delta \chi^2$</th>
<th>RMSEA</th>
<th>GFI</th>
<th>AGFI</th>
<th>CFI</th>
<th>NNFI</th>
<th>SRMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>independent model</td>
<td>1974.02(36)</td>
<td>54.83</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>one-factor model</td>
<td>82.14(27)</td>
<td>3.04</td>
<td>1891.88*</td>
<td>.083</td>
<td>.94</td>
<td>.90</td>
<td>.97</td>
<td>.96</td>
<td>.046</td>
</tr>
<tr>
<td>two-factor model</td>
<td>63.52(26)</td>
<td>2.44</td>
<td>18.62*</td>
<td>.070</td>
<td>.95</td>
<td>.92</td>
<td>.98</td>
<td>.97</td>
<td>.038</td>
</tr>
</tbody>
</table>

In conclusion, through the two-stage competitive model, we found that the two-factor oblique model had a better fit to the theory according to the dimension of learning with media (LWM) and media communication and ethics (MCE).

**Convergent Validity**

The results of our two-factor CFA model are presented in Table 4. All of the factor loadings from the items to their latent factors were significant, and the composite reliabilities were all above 0.60. These results provide evidence for the convergent validity of our scale.

<table>
<thead>
<tr>
<th>Factors</th>
<th>items</th>
<th>Standard solution</th>
<th>$R^2$</th>
<th>S.E.</th>
<th>C.R.</th>
<th>Composite reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning with media (LWM)</td>
<td>m_1_b</td>
<td>I understand how to operate media technology devices.</td>
<td>.62</td>
<td>.68</td>
<td>.46</td>
<td>.05</td>
<td>12.35</td>
</tr>
<tr>
<td></td>
<td>m_1_c</td>
<td>I can select appropriate types of media based on my learning needs.</td>
<td>.67</td>
<td>.60</td>
<td>.36</td>
<td>.06</td>
<td>10.67</td>
</tr>
<tr>
<td></td>
<td>m_2_a</td>
<td>I am familiar with the operational functions of media equipment that is used to broadcast learning content.</td>
<td>.74</td>
<td>.78</td>
<td>.61</td>
<td>.05</td>
<td>15.06</td>
</tr>
<tr>
<td></td>
<td>m_2_b</td>
<td>I use different media technology to store/backup learning content.</td>
<td>.76</td>
<td>.78</td>
<td>.60</td>
<td>.05</td>
<td>14.91</td>
</tr>
<tr>
<td></td>
<td>m_2_c</td>
<td>I use media for my learning tasks.</td>
<td>.71</td>
<td>.67</td>
<td>.44</td>
<td>.06</td>
<td>12.11</td>
</tr>
<tr>
<td>Media</td>
<td>m_3_a</td>
<td>I understand the content that is conveyed by media.</td>
<td>.64</td>
<td>.66</td>
<td>.44</td>
<td>.06</td>
<td>11.64</td>
</tr>
<tr>
<td></td>
<td>m_3_c</td>
<td></td>
<td>.68</td>
<td>.64</td>
<td>.41</td>
<td>.06</td>
<td>11.17</td>
</tr>
</tbody>
</table>
I discuss the displayed contents of media with others. 

I possess an accurate understanding of media use. 

I comply with the intellectual property rights of media use.

We followed the procedures proposed by Anderson and Gerbing (1988). Discriminant validity was established using chi-square difference tests to compare an unconstrained measurement model with a constrained model (in which the correlations between two latent factors are set equal to one). Table 5 indicates that the $\Delta \chi^2$ was significant and that two factors can be discriminated in our scale.

<table>
<thead>
<tr>
<th>Variable</th>
<th>model</th>
<th>$\chi^2$</th>
<th>DF</th>
<th>$\Delta \chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>MLSS</td>
<td>unconstrained model</td>
<td>63.52</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td></td>
<td>constrained model</td>
<td>198.65</td>
<td>27</td>
<td>135.13***</td>
</tr>
</tbody>
</table>

**Student Scores on the Scale**

Table 6 indicates the average item scores and the standard deviations on the two subscales of the MLSS. Students scored highest on the media communication & ethics subscale (with an average score of 4.23 per item), followed by the learning with media subscale (with an average score of 4.21 per item). The standard deviations of both two subscales are moderate and the students’ scores are close to each other. The results indicate that, on average, the students demonstrated essential media literacy in a technology-enriched learning environment.

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Items</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>LWM</td>
<td>5</td>
<td>4.21</td>
<td>.75</td>
</tr>
<tr>
<td>MCE</td>
<td>4</td>
<td>4.23</td>
<td>.70</td>
</tr>
</tbody>
</table>

**Gender Differences on the Scale**

This study further compares the scores of the male and female students on the two subscales of the MLSS. The results of independent t tests are presented in Table 7, revealing that these gender scores on both subscales were significantly different at the 0.05 level. Female students expressed more positive perceptions of learning with media and of media communications & ethics. In other words, the male students perceived they were less media literate.

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Gender</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>LWM</td>
<td>female</td>
<td>4.38</td>
<td>.60</td>
<td>2.66**</td>
</tr>
<tr>
<td></td>
<td>male</td>
<td>4.17</td>
<td>.72</td>
<td></td>
</tr>
<tr>
<td>MCE</td>
<td>female</td>
<td>4.30</td>
<td>.67</td>
<td>2.54*</td>
</tr>
<tr>
<td></td>
<td>male</td>
<td>4.08</td>
<td>.85</td>
<td></td>
</tr>
</tbody>
</table>

Note: N= 149 for female; N=151 for male; *p<0.05, **p< 0.01

**Grade Comparisons on the Scale**

To examine the possible effects of grade level, this study also compared the score of the fifth and sixth graders on the two subscales of the MLSS. In general, the latter group scored higher on the two subscales (LWM and MCE) than did the former. However, the results of independent t tests revealed that both fifth and sixth graders perceived similar levels of competency on each subscale (Table 8). Overall, comparisons of the MLSS scores indicated that students at the advanced grade level did not necessarily rate themselves higher in media literacy.
### Table 8 Grade Comparisons on Subscales of the MLSS

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Grader</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>LWM</td>
<td>5th</td>
<td>4.25</td>
<td>.70</td>
<td>-.50</td>
</tr>
<tr>
<td></td>
<td>6th</td>
<td>4.29</td>
<td>.64</td>
<td></td>
</tr>
<tr>
<td>MCE</td>
<td>5th</td>
<td>4.15</td>
<td>.76</td>
<td>-.88</td>
</tr>
<tr>
<td></td>
<td>6th</td>
<td>4.23</td>
<td>.78</td>
<td></td>
</tr>
</tbody>
</table>

Note: N = 146 for the 5th graders; N = 154 for the 6th graders; *p < 0.05

### DISCUSSION AND CONCLUSIONS

To encourage high-quality research, to enable integration and consistency across research studies, and to increase our understanding of media literacy, there is a need for a valid and reliable measure of the media literacy construct. This study completes an exploratory-confirmatory research cycle by more rigorously validating the MLSS. Completing this cycle is important because it required an added precision in the model specification. From the above analysis, a two-factor, nine-item instrument with good psychometric properties for measuring the media literacy of elementary school students was developed. This study presented an empirically validated model to measure the media literacy of elementary school students. The nine-item MLSS instrument that emerged was demonstrated to produce acceptable reliability estimates, and the empirical evidence supported its content validity, discriminant validity, and convergent validity. Therefore, this revision of the MLSS instrument can be utilised to assess the media literacy of elementary school students.

The results of this study revealed that female students tend to be more media literate than their male counterparts for the 5th and 6th grades elementary students. This result is inconsistent with previous studies (Chang, 2008; Lee & Yuan, 2010; Liu & Lin, 2010; Tsai, Lin, & Tsai, 2001; Yen & Lee, 2011) that examined gender differences in technology-related attitudes, which have generally indicated that male students held more positive attitudes towards technology than did female students. There are several possible explanations for the superior media literacy of the female students. First, boys may spend more time outdoors with their peers, playing sports and hanging out (Lemish, Liebes, & Seidman, 2001), whereas females spend more time reading, writing and listening to music (Trainor, Delfabbro, Anderson, & Winefield, 2010). Second, girls may use media in more diverse ways, spreading their literate activities over the different modalities (Unlusoy, de Haan, Leseman, & van Kruistum, 2010), whereas boys may still be more focused on related new technology such as mobile devices (Yen & Lee, 2011). Finally, male students may view technology as a playful toy, whereas female students may treat it as a tool to accomplish a task (Lee & Yuan, 2010). Therefore, girls may demonstrate a higher level of engagement in media literacy, allowing them to outscore boys on both subscales of the MLSS. The media literacy practices of girls, who may seem to be in a disadvantaged position in relation to new media, are put in a different light when their use of new media is placed within the broader spectrum of media use. Consequently, educators should take gender differences into consideration when developing media instructional activities. For example, robotics may be integrated into learning activities to promote male engagement in media literacy (Liu, 2010).

With regard to grade level, both fifth and sixth graders acquired similar levels of knowledge and skills and had similar attitudes and perceptions towards media literacy. Accordingly, grade (or age) differences were not determining factors of this ability. In general, higher grade students are more media literate than lower grade students. However, it seems not so trivial or irreverent in our case. One possible explanation for this result is that both fifth and sixth graders had similar experiences about using media and they were just one grade difference. For example, they have to understand the basic operations of word processing software in their computer classes. Future studies may compare students with a larger grade difference to see if the result is still the same.

This study presents a convenient tool to assess the perceptions towards media literacy of elementary school students, based on learning with media and media communication & ethics. Using this tool, teacher educators and researchers can more deeply explore the role that views about media literacy plays for elementary school students. Even though the rigorous validation procedure allows us to develop a general instrument for measuring media literacy, this work has some limitations that could be addressed in the future. First, while the valid instrument was developed using sample data gathered in Taiwan, a cross-culture validation (using another large sample gathered elsewhere) would be required for further generalisation of the instrument. Additionally, the sampling method has potential bias, as a sample of willing respondents may not generalise to the population of all students. Consequently, other samples from different areas or nations should be gathered to confirm and refine the factor structure of the MLSS instrument and to assess its reliability and validity.
ACKNOWLEDGEMENT
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REFERENCES

Appendix A

Items of the MLSS

<table>
<thead>
<tr>
<th>Coding</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>m-1-a</td>
<td>I can understand different types of media (e.g. visual media, audio media) and their principles.</td>
</tr>
<tr>
<td>m-1-b</td>
<td>I can understand how to operate media.</td>
</tr>
<tr>
<td>m-1-c</td>
<td>I can understand the content that media convey.</td>
</tr>
<tr>
<td>m-2-a</td>
<td>I can be familiar with the operational functions of media equipment to broadcast the learning content.</td>
</tr>
<tr>
<td>m-2-b</td>
<td>I can use different media technologies to store/backup the content.</td>
</tr>
<tr>
<td>m-2-c</td>
<td>I can discuss with others the content that media display.</td>
</tr>
<tr>
<td>m-2-d</td>
<td>I can select appropriate media to edit the messages that I want to convey.</td>
</tr>
<tr>
<td>m-3-a</td>
<td>I can use media to carry out daily learning.</td>
</tr>
<tr>
<td>m-3-b</td>
<td>I can use media appropriately to convey ideas (e.g. use a camera to record events).</td>
</tr>
<tr>
<td>m-3-c</td>
<td>I discuss the displayed contents of media with others.</td>
</tr>
<tr>
<td>m-4-a</td>
<td>I possess the accurate understanding of media use.</td>
</tr>
<tr>
<td>m-4-b</td>
<td>I can cherish and conserve media equipment.</td>
</tr>
<tr>
<td>m-4-c</td>
<td>I can comply with the intellectual property rights of media use.</td>
</tr>
</tbody>
</table>
DEVELOPING COMPUTATIONAL FLUENCY WITH THE HELP OF SCIENCE:
A TURKISH MIDDLE AND HIGH SCHOOL GRADES STUDY

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ABSTRACT
Students need to achieve automaticity in learning mathematics without sacrificing conceptual understanding of the algorithms that are essential in being successful in algebra and problem solving, as well as in science. This research investigated the relationship between science-contextualized problems and computational fluency by testing an instructional method that was implemented as a non-traditional drill exercise. The study employed a quantitative analysis of pre- and post-test scores of Turkish middle and high school students after two interventions. The questions addressed were: Do the science-contextualized drill practices (SCP) improve students’ computational fluency better than traditional drill practices (TP)? Is there any statistical significance between middle and high school students in terms of their benefit from SCP? This study showed that science-contextualized drill exercises produced higher gains for both middle and high school students’ computational fluencies than the traditional context-free drill exercises.

Keywords: computational fluency, integration, mathematics education

INTRODUCTION
Mathematics conceptualization was the primary focus of the Principles and Standards for School Mathematics (PSSM) document which was developed and published in 2000 by the National Council of Teachers of Mathematics (NCTM). While it was an improvement over the standards of 1989 and 1995 that may have inadvertently given the impression that computation should be de-emphasized (Hartocollis, 2000), in fact, improving automaticity with computational facts and mathematical precision was presented as an integral part of conceptual mathematics learning in PSSM (Ferrini-Mundy, 2000). In order to strengthen its position on this matter, NCTM issued a document called Curriculum Focal Points (CFP) in 2006 that listed the most critical mathematical topics to be taught at schools. As a result, CFP was emphasizing the importance of basic arithmetic skills in lower and middle grades stronger than ever.

However, CFP was perceived by the media as an admission that the PSSM had originally recommended reduced instruction in basic arithmetic facts (Lewin, 2006). NCTM responded to the image displayed by the mainstream media and concluded that CFP fully supported the PSSM and “it is in no way a reversal of the NCTM’s long-standing position on teaching students to learn critical foundational topics (e.g. multiplication) with conceptual understanding” (National Council of Teachers of Mathematics [NCTM], 2006, ¶ 9).

Today, NCTM’s position on teaching students critical foundational topics is clearer: Teaching mathematics should be based on conceptual understanding with an emphasis on computational fluency, and “computational fluency should develop in tandem with understanding of the role and meaning of arithmetic operations in number systems” (NCTM, 2000, p. 32). Still, by not providing examples of concrete instructional methods, FCP did not diminish the apprehensions of those who has been worried about math wars (Van de Walle, 1999), thus teachers are left to fix on between two sides of the war or to segregate their lessons into conceptual and computational sections (Galley & Manzo, 2004). Even more to worry is the speculation that FCP might be interpreted by educators as if it encourages computational fluency (including algorithmic precision) to be taught only within the domain of arithmetic, and thus students would not need to practice it after elementary grades. A similar topic of discussion was explained in Howe’s (1998) critic over decreased attention tables in standards document, and how it was often interpreted as no attention to certain topics of mathematics.

In correlation with NCTM’s position, the question of how to build computational proficiency was paramount and several studies have shown that rote, behaviorist traditional practice was not an effective means for developing computational fluency (Davis, 1984; Ginsburg, 1997; Webb, 1991). Thus, the driving question in this study was...
to understand the relationship between science-contextualized problems, and computational fluency by testing an instructional method that was implemented as a non-traditional drill exercise — in the sense of a creative and interdisciplinary approach — to foster computational fluency.

The questions addressed in this study were:
1) Do the science-contextualized drill practices (SCP) improve students’ computational fluency better than traditional drill practices (TP)?
2) Is there any statistical significance between middle and high school students in terms of their benefit from SCP?

THEORETICAL FRAMEWORK
A Philosophical Debate on Algorithms
The composition of mathematics is a controversial issue; however people from all disciplines agree that arithmetic, algebra, problem solving and geometry are the essentials of mathematical thinking. Almost all advanced applications of mathematics rely on good knowledge of arithmetic that makes the conceptual understanding of the latter topics possible. Despite the consensus between the two sides of the math wars on the importance of arithmetic, there has still been an on-going debate on the role of algorithmic computations in teaching arithmetic. Although some claim this debate is a philosophical one (Davison & Mitchell, 2008), there are philosophers who believe it is a pedagogical issue. For example, the ideas of 20th century mathematician and philosopher A. N. Whitehead who believed education should attain automaticity so that the mind is free to learn higher-level problems (Ocken, 2007) are noteworthy. Whitehead diverged from the notion that students are obliged to always think about what they are doing. He believed thought should come with a critical consciousness, which results from attention and elimination of the unrelated (Whitehead, 1938). Whitehead’s automaticity is better-responded in second language learning (McLaughlin, 1979), and is defined as the point at which a person no longer has to think about the rules of pronunciation, grammar, or the syntax (Brown & Campbell, 2002). Yet, Whitehead considered life as an organic entity and according to him learning should be beauty-centered and holistic (Ernest, 2000), and mathematics is not to train the mind for future challenges but should work for the moment (Whitehead, 1929). Therefore, Whitehead’s philosophy suggested that emphasizing algorithms as a way to achieve automaticity in learning mathematics does not sacrifice conceptual understanding (Wu, 1999) or dispute scientific constructivism in the sense that it is self-dependence on individual cognitive abilities to understand, recognize, and create. Because, according to Whitehead, education is “…the acquisition of the art of the utilization of knowledge” (1929, p.4).

Clearly, when the focus is on pedagogy rather than philosophical differences, it is easier to reach a consensus on the role of algorithms in mathematics teaching. Whitehead’s views might be helpful in achieving what Dr. Ball tried to do by bringing concrete examples of instruction so that educators may discuss two sides of the story and develop their own styles in achieving computational fluency through effective instructional strategies according to their students’ individual needs (Galley & Manzo, 2004).

The consensus on the role of algorithms in mathematics education suffered from extremist approaches in the past. In response to proclamations that technology changed the very nature of mathematics by making calculations easier (NCTM, 1989), and to articles such as Leinwand’s It’s time to abandon computational algorithms (1994), a committee of the American Mathematicians Society (AMS) had to remind that the algorithms of arithmetic form the basis of more advanced mathematics topics such as the concept of real numbers and algebra of polynomials (Howe, 1998). On the other edge, there was the back to basics curriculum in the U.S. which “…focused largely on skills and procedures” (Schonfeld, 2004, p. 258) and to which NCTM reacted with its standards approach in 1980’s.

The Definition of Computational Fluency
Computational fluency has been misunderstood by many as the set of rules of arithmetic; similar to problem solving which was once interpreted as students solving simple word problems so that algorithmic calculations could be avoided (Schonfeld, 2004). The lack of a common definition caused researchers to use concepts such as algorithmic thinking, algorithms, computation, arithmetic, etc. interchangeably, and even sometimes incorrectly (Howe, 1998).

Fuchs et al. (2006) provided 3+2 as an example of arithmetic whereas 35+29 of algorithmic computation due to incorporation of automaticity in the first example. If students were still using a strategy for 3+2, for example, counting up; for determining the answer then it would be algorithmic (Carpenter, Fennema, & Franke, 1996). Thus, algorithmic computation as it is used in this study involves systematic processes comprised of operation(s) and relative symbols to reach to the solution rather than memorized answers to a mathematical problem.
However, efficiency, in the sense of automaticity, should still be an essential target of algorithmic computation teaching (Howe, 1998) as well as flexibility, and accuracy (Russell, 2000).

Lastly, NCTM (2000) brought a general clarity and defined computational fluency as having and using efficient and accurate methods so students can perform computations in a variety of methods such as mental calculations, estimation, and paper-and-pencil calculations by using mathematically sound algorithms.

**Computational Fluency and Concepts around It**

National Advisory Panel’s report (2008) on mathematics education in U.S. pointed out that algorithmic computational skills and conceptual understanding reinforce each other. Similarly Turkish Ministry of National Education’s (MONE) report (2005a) also recommended that mathematics education at Turkish schools should focus on conceptual understanding together with the goal of improving computational skills.

However, we know a little about the role of computational skills on student achievement, particularly in middle and high school levels. Some researchers followed cross-national studies and concluded that computational abilities of American students might substantially narrow down the achievement gap between East Asian students (Geary, Liu, Chen, Saults, & Hoard, 1999; Mayer, Tajika, & Stanley, 1991). Tolar, Lederberg, and Fletcher (2009) said that computational fluency was correlated with achievement in higher-level mathematics courses and suggested that classroom practices should include a component that improves adolescents' computational fluency, even during the high school years. Although, the researchers indicated that algorithms as operational mathematical expressions were not enough to be successful in algebra (Tolar, Lederberg, & Fletcher, 2009), automaticity with numerical operations were found to be noticeably influence problem solving skills of pre-adolescent children (Royer, Tronsky, & Chan, 1999).

In Fuchs et al. (2006) research on elementary grades, it was found that arithmetic (r=0.56) and attentive behavior (r=0.60) were the only two significant predictors of success in algorithmic computation. Russel and Ginsburg (1984) and Ackerman and Dykman (1995) also found that inattentive behavior can cause low achievement in computational fluency. Another research suggested that an empirically-selected intervention over student-selected one produced higher gains in computational fluency (Carson & Eckert, 2003).

Torigoe (2008) suggested that numbers allow students to compare their results with their everyday experiences and numeric problems helped students deal with unit conversions. Moreover, Torigoe recommended that science teachers should present the new material with numeric examples until the idea was understood. The researcher found that most science teachers taught their subject symbolically and this did not help students master the content. In Torigoe’s research, when answering questions with contextualized computation, ~95% of the students answered correctly as compared to ~25% when answering parallel questions without computation. It showed that computation was facilitated when students were provided with numbers in the problem context as compared to the abstract algebraic notation.

**Turkish Case**

Initially, school mathematics and science in Turkey followed a strictly linear hierarchical curriculum model until the 2004 reform movement (Bulut, 2007). It was assumed that students would master computational fluency by the end of elementary school. Besides the fact that reform has not yet had any positive effect on Turkish students’ performance in international comparison studies (Zembat, 2010), students are still not allowed to use calculators neither in the classroom (Ozgun-Koca, 2009) nor during central examinations. Baki and Celik’s study (2005) found that teachers believed using calculators in class would inhibit the computational fluency of their students and would result in not being able to finish their work in time during multiple-choice tests.

**Mathematics in Science and Mathematics Taught by Science Teachers**

It was suggested by MONE (2005a) that more emphasis on applications taken from science curricula should be applied in Turkish mathematics classrooms. However, it is documented that science and mathematics teachers in Turkey do not work in collaboration, and most math teachers were not equipped with necessary science knowledge (Turkish Academy of Sciences [TUBA], 2004). The consequence for this lack of coordination and integration between subjects was that Turkish students learned mathematics as an abstract science with minimal real-life connection (TUBA, 2004). Similarly, MONE (2005b) proposed that science teachers should work along with teachers from other disciplines to enrich classroom learning.

There is a need of empirical research on the mathematical content knowledge (CK), and pedagogical content knowledge (PCK) of science teachers because “unlike the mathematics teacher who can choose to avoid science, the science teacher is not able to cover most topics without calling on mathematical concepts and skills”
The assumption that science teachers know mathematics needs to be substantiated, because having mathematical sense means more than just manipulating numbers (Kulm, 2008), and according to the RAND Mathematics Study Panel’s report (2003) even math teachers are unable to explain why basic mathematics algorithms worked. Considering the fact that students in Turkey are introduced to scientific constants such as Avogadro’s number or Newton’s gravitational constant as early as in eight-grade, the importance of a revision of computational fluency in science classes is prominent. High school physics and chemistry classes are also subjects in which computational fluency is heavily used. Torigoe (2008) indicated that algorithmic manipulation was what most physics tests measure.

Webb (1975) delineated some causes of difficulty for science teachers in teaching mathematical concepts as a) unfamiliarity with the symbols, mathematical language and methods, b) the timing and depth of development of certain mathematical topics in science classroom, c) lack of familiarity with the use of mathematics concepts, and d) failure to relate teaching of mathematics to other subjects adequately (in particular science).

**METHODOLOGY**

**Intervention**

Exponentials (indices) was chosen as the unit of study because it is one of the two common mathematics-related topics (the other one is dimensional analysis) that is explicitly covered in middle and high school science curricula in Turkey. Secondly, all participating students had seen this topic before. The first intervention was a review of basic concepts of exponentials unit (including scientific notation) which lasted for two class periods and implemented by the science teachers. Lesson plans were designed together by the researchers and the corresponding science teachers. Conceptual understanding of the algorithms in exponentials was the main objective of this intervention.

**Instrumentation**

This study employed a quantitative analysis of pre- and post-test scores of middle and high school students after two interventions. Both pre-test (Cronbach’s $\alpha = 0.60$) and post-test (Cronbach’s $\alpha = 0.63$) each comprised of 10 multiple choice questions on exponentials were produced alike to end of middle school exam questions in Turkey by an expert mathematics teacher. Both tests were required to be solved in 20 minutes each and students were not allowed to use calculators.

The pre-test was administered before the second intervention, which was a set of assignments given to the students to be completed individually at home. Homework assignments were handed out to evenly divided control and experiment groups in each category, and students were reminded that they had to show their work and that they were not allowed to use calculators. The correct answers of the assignments together with a complete detailed solution of the problems of that day were given to the students with their new homework. Control group homework included TP type questions whereas the experiment group homework contained the same questions which were presented in contexts chosen from science curriculum (SCP). By this way, problem...
solving component was controlled so algorithmic computation could be tested for significance between the groups. An example question from the homework intervention was as follows:

TP type question: Find the solution in scientific notation \( \frac{4.2 \times 10^{18}}{150 \times 10^{14}} = ? \)

SCP type question: The Richter magnitude scale, also known as the local magnitude \((M_L)\) scale, assigns a single number to quantify the amount of seismic energy released by an earthquake. An earthquake that measures 8.0 on the Richter scale releases \(4.2 \times 10^{18}\) Joules of energy, while the same energy for a 5.0 magnitude earthquake is \(150 \times 10^{14}\) Joules. How many times more energy is released at 8 Richter scale than 5 Richter scale? Calculate the answer by dividing the two given amounts and write the answer in scientific notation.

Participants

Participants of this study were students of a public elementary K—8 school, and 9—12 grades public high school in a major metropolitan city in Turkey \((N_{\text{total}}=150)\). The public school list was drawn from MONE website (http://istanbul.meb.gov.tr/) and the elementary school was randomly selected with the help of a computer program. The area where the participants were selected is a developing district of the city and it is heavily populated by working class. The schools are located in the district center, and they admit students on the basis of proximity to the schools.

Seventy-five of the participants were middle school grades 7 and 8 students, whereas the rest \((n_{\text{high school}}=72)\) were high school grades 9 and 10 students. Our sample consisted of 84 male students and 66 female students. The attendance during the course of the study never dropped below 90% in any class.

Data Analysis

The student scores from pre- and post tests were calculated by adding up the exactly correct answers they have given in pre- and post-tests. Their achievement in exponentials unit was calculated by students’ total score as a measure of their computational fluency, which was the independent variable in our study. In order to determine the statistical differences in the pre-, post tests, and delta scores (pre-test score subtracted from post-test score) between the control and experiment groups, normality of the data was confirmed by comparing the histograms of pre-, post-tests, and delta scores in the whole sample. Secondly, homogeneity of variance assumption was tested with Levene’s test for equality of the variances, and no statistical significance in variances was found \((p<0.05)\). These two steps made it possible to conduct an independent samples t-test.

In order to answer the research question about the differences on computational fluency between two grade levels, the data was split into middle and high school student categories. Although the normality was achieved for each category on all variables, homogeneity of variance assumption was found to be violated only for middle school post-test variable according to Levene’s test \((p=0.001)\). Statistical significance between the means of control and experiment groups was investigated with the consideration of this result.

Effect sizes (ES) were calculated by adjusting Cohen’s d for delta scores (Wilson, 2010). Pearson’s \(r\) was computed for the correlation between the post- and pre-test scores. Thus,

\[
ES = \frac{\text{Mean}_{\text{post-test}} - \text{Mean}_{\text{pre-test}}}{SD_{\text{pooled}}} \quad (1)
\]

\[
SD_{\text{pooled}} = \frac{SD_{\text{delta}}}{\left(2 \times (1-r)\right)^{1/2}} \quad (2)
\]

were used to calculate the effect sizes.

RESULTS

Table 1 contains the descriptive analysis of the whole sample in which means and standard deviations of pre-, post-test scores and their difference between —delta scores—are given. The table also presents these statistics as they are calculated separately at middle and high school grade levels.
Table 1: Mean and Standard Deviation Scores of Pre- and Post-tests with Grade Levels

<table>
<thead>
<tr>
<th></th>
<th>Control Group (n=75)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-Test Mean</td>
<td>SD</td>
<td>Post-Test Mean</td>
<td>SD</td>
<td>Delta Mean</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>Middle School</td>
<td>6.26</td>
<td>1.76</td>
<td>6.80</td>
<td>1.92</td>
<td>0.54</td>
<td>1.39</td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>8.61</td>
<td>1.02</td>
<td>8.69</td>
<td>0.98</td>
<td>0.08</td>
<td>1.46</td>
<td></td>
</tr>
<tr>
<td>Whole Sample</td>
<td>7.39</td>
<td>1.87</td>
<td>7.71</td>
<td>1.80</td>
<td>0.32</td>
<td>1.43</td>
<td></td>
</tr>
</tbody>
</table>

Note. Both pre- and post-tests contained 10 questions. SD = Standard deviation.

Independent samples t-test at 95% confidence level provided no statistically significant difference (p=0.70) in pre-test scores between the groups after the first intervention, and it was concluded that the groups were at a close starting point before the second intervention in terms of their achievement on exponentials topic. The analysis procedure was repeated for each sub level data —middle (p=0.31) and high school (p=0.46) — and verified to be the same.

After the second intervention ended, the post-test was administered in the classrooms. The analysis of the data (independent samples t-test) indicated a statistical significance for p<0.05 between the groups in post-test (p=0.000363) and delta scores (p=0.000266). Figure 1 contains confidence intervals around the means of pre- and post-tests for control and experiment groups, while Figure 2 shows the confidence intervals of the mean delta scores.

![Figure 2. 95% Confidence Intervals around the Mean of Pre- and Post-test scores](image-url)
In addition, there was also a statistical significance at post-test and delta scores between the control and experiment groups when middle and high school data were analyzed separately (p < 0.05 for each four categories). The study found evidence in both the pre- and post-test scores that middle and high school student scores differed significantly (p < 0.05) from one another. However, when the delta scores were investigated, middle school students had a statistically higher result than their peers in high school (p < 0.05).

Finally, there was a correlation between pre- and post-test scores for the whole sample (r=0.63, p<0.01), as well as for middle (r=0.63, p<0.01) and a very strong relationship for the high school sample (r=0.95, p=0.08). Thus, according to equation (1), ES was calculated as 0.63 accounted for the variance in the whole sample post-test score. The ES value for middle school post-test was very high (ES=0.82) but relatively low for high school significance (ES=0.17).

CONCLUSIONS

Previous research had already shown that traditional drill exercises that contain non-contextualized repeated algorithmic procedures are not effective ways to improve computational fluency (Davis, 1984; Ginsburg, 1997; Webb, 1991). Thus, mathematics teachers should develop alternative instructional methods to help their students practice algorithms together with their conceptual understanding. This study showed that science-contextualized drill exercises produced higher gains for both middle and high school students’ computational fluencies than the traditional drill exercises.

An important conclusion derived from this finding is that science is an effective domain to foster computational fluency. On the other hand, since computational fluency is frequently used in science, science teachers can easily integrate it into their own lessons. In relation to previous research (Torigoe, 2008), two possible benefits of practicing computational fluency in science lessons that are supported by our findings were; 1) there would be more class time to foster conceptual understanding of more complex algorithms in mathematics and focus on
problem solving strategies, 2) students would learn science topics better when they deal with numerical examples.

Gobet and Campitielli (2007) suggested practice drill require effort and are not enjoyable to the students. They claimed “Most students are incapable of working on practice activities for long periods of time” (p.160). The intervention in this study was designed in a way to increase student attention while practicing computational fluency. Thus, it was also noteworthy that the delta scores of middle school students were higher than those of the high school students. This can best be explained by the comfort of the high school students with exponentials unit. However, in correlation with Fuchs et al’s findings (2006), it can also be speculated that the intervention of this study increased middle school students’ attentive behavior towards the drill exercises more than it did for high school students.

DISCUSSION
Teachers of mathematics should focus on pedagogy and try to find better instructional methods to reach to their students instead of being a part of philosophical discussions in math wars. Computational fluency is one of the key areas of mathematics in which better instructional methods should be developed at all grade levels. In order to help our students excel and maintain their skills in computational fluency, computational fluency should be the target of each grade level, it should be re-visited and practiced extensively throughout the k-12 curriculum. However, computational fluency should not be the concern of mathematics teachers only. In particular, science and technology, and in general, all subject teachers should help students develop computational fluency by integrating mathematics into their lessons.

Due to the increased pressure of high-stakes testing in the world, and the large volume of participants waiting to get admitted to universities in Turkey, there seems to be no change in the selection-based multiple-choice centralized testing method in the near future. It is also very unlikely that there will be a policy change in the use of calculators during these exams since computational fluency is a skill that causes large variance among students. Students definitely need to excel on computational fluency to save time at a test to spend on more complex dimensions of mathematics questions. The conceptual understanding of the algorithms is also important to be successful in those complex dimensions. Teachers of mathematics need to help their students achieve both aspects of computation. Science emerges as a convenient medium to get this help from, as it naturally provides the context. Having said this, practicing computational fluency in science classes will also ease the load of the mathematics curriculum, and thus teachers of mathematics can have more time to focus on developing their students’ problem solving skills. Students will also have more time to focus on conceptual understanding of science topics if teaching and practice of computational fluency is shared between subjects.

Recommendations for future research include an extension of this study into the qualitative domain and investigate the possible reasons behind the usefulness of the SCP and its relationship with attentive behavior. Secondly, there is a need for further research on the mathematical ability of science teachers, particularly on their mathematics CK and PCK.

REFERENCES


EFFECT OF SELF-WORTH AND PARENTING STYLE ON THE PLANNED BEHAVIOR IN AN ONLINE MORAL GAME

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ABSTRACT
This idea of integrating moral education to digital gaming platform had been discussed since digital and online approaches were used in teaching. Online interactive instruction was one of moral teaching forms to assist moral instruction. However, most moral-related interactive online games lacked functions for players to explore themselves while game playing, that resulted in less participation in deeper learning and decrease understanding of moral values. Therefore, we, digital game-based learning lab of National Taiwan Normal University, developed the interactive moral online game, named ‘To do or not to do’, to help students explore and establish appropriate moral values. Results of Partial Least Squares (PLS) analyses indicated that behavioral intention was significantly influences by behavioral control, self-worth, attitude toward the game, subjective norm and parenting style.

Keywords: self-worth, parenting style, theory of planned behavior, game-based learning, e-learning

INTRODUCTION
Based upon previous studies (e.g. Apple, 1989, 1993; Giroux, 1983a; Gordon, 1991), Yuksel (2005) reported that there are two sorts of curricula in schools; first type refers to ‘official curriculum’ which consisted of well-written objective, goals and activities; the second type is ‘hidden curriculum’ which conveys rules, values and implied messages teachers pass to students. According to Yuksel (2005), Kohlberg, the educators and the first researcher, focused on hidden curriculum in moral education. Kohlberg believed that both formal and hidden curriculum provide a ground for the moral development of students. Students experience resolution of ethical conflicts or dilemmas which lead them to the next moral stage. The course of moral development is from a simpler idea to a more complex idea, it is a progressive development.

The internalized value has been placed an important role in children’s moral decisions in different domains (Costanzo & Fraenkel, 1987). However, students are taught with values that they are demanded to learn through class lectures. Earlier study done by Pounds (1969) stated that problem solving as “choosing a model, comparing it to reality, identifying differences, selecting a difference, considering operators, evaluating consequences of operators, selecting an operator, and executing an operator”; and transforming a given situation into a desired situation or goal (Hayes, 1989). For the purpose of the study, research participants were put in a moral dilemma.
which can be seen as a way of presenting problem, exploring the appropriateness of moral for an individual or a group to deal with values relating to human conduct, with respect to the rightness and wrongness of certain actions.

With concerns about the rapid increase in the incidence of misbehavior in elementary schools, researchers have turned their attention to ways parenting dimensions affect children’s moral education. Past researchers had demonstrated that parents influenced children’s development of cognitive belief structure (Glasgow, Dornbusch, Troyer, Steinberg, & Ritter, 1997). With the structure children possessed, they conduct their behavior and then form characteristics of themselves and others (Grusec, Goodnow, & Kuczynski, 2000). Therefore, the examination of parenting style on children’s ways of thinking in a situated game which consequences-based normative moral problem-solving technique (Hooker, 1996; Lucas, 2000a) was embedded might be helpful to better understand children’s insights.

Currently educators face challenge to strike a balance to the moral development of students and the academic achievement of students. How could teachers prepare students not only actively participate in the environment but also make their own choice with justness, and accuracy? How could we develop a program or a curriculum of moral education that encompass the universal morality for use in both school and family?

For the purpose of the study, an online moral game was developed to provide moral-related situations relate to students’ life, and question them with different situations and events enabling them to think creatively and critically, test their tolerance, honesty, and problem-solving tendencies. We examine the relationships among self-worth, parenting style and the planned behavior by using this online moral game.

**Theoretical Framework**

**Moral development**

For researching whether moral reasoning develops in a predictable sequence, Kohlberg (1981, 1984) provided research participants with ‘hypothetical dilemmas’ that often put the value of life against the value of someone’s life, or put the value of one individual’s life against the value of several people’s lives. Kohlberg concluded that moral reasoning occurs in a sequence of three levels. Each level includes two stages, for a total of six. According to Kohlberg, every child starts out at the pre-conventional level, reasoning strictly in terms of ego-centered considerations. The child initially focuses on avoidance of punishment and obtainment of rewards (Stage 1) and then on satisfaction of self-interests (Stage 2). Next follows the conventional level and a shift to group-centered considerations. Here the focus is on adhering to the norms of family and other groups to which one belongs (Stage 3) and maintaining social order (Stage 4). The third post-conventional level goes beyond both the self and one’s society—reminiscent of the Piaget adolescent’s perspective. Here the emphasis is on democratic procedure and social utility (Stage 5) or universal principles pertaining to justice and individual rights (Stage 6).

**Self-worth**

Once a person recognizes the self as an individual and separate being, he or she begins to construct a ‘self-concept’ which refers to how that individual perceives his or her ‘self’ to be in terms of ability, value, and limitations. Hater (1990) defined self-concept as an individual’s perception of the combination of different aspects of the self and thus it was viewed as a multidimensional construct.

Coopersmith (1967) proposed a construct to assess self-concept by combining an individual’s self-evaluation across items of various domains. Crocker, Luhtanen, Cooper and Bouvrette (2003) identified seven Contingencies of Self-Worth Scales (CSWs) including: others’ approval, appearance, family support, academic competence, virtue, competition, and God’s love. Parental values might lead children to experience domains and use the structure to build and judge the content of their contingencies of self-worth.

**Parenting style.**

Baumrind (1967) was the first researcher developed the concept of parenting styles which she referred to authoritative, authoritarian, indulgent, and neglectful. Authoritative parents required children to follow their demands, and they recognized the flexibility as well. Authoritarian parents required children to follow their demands, but these parents were not responsive to the children’s perspective. Indulgent parents did not require children be responsive to their demands, but they were responsive to the children’s perspective. Finally, neglectful parents neither require children be responsive to their demands nor responsive to the children’s perspective.

Past study done by Maccoby and Martin (1983) reported that parental warmth, emotional support, appropriate autonomy, and clear communication lead to positive developmental outcomes in children and adolescents.
Moreover, children who are raised in authoritative homes have high scores on social development, mental health, and self-esteem (Baumrind, 1989; 1991; 2005).

**Theory of planned behavior.**

Theory of Planned Behavior (TPB) was developed to state that one’s behavior can be predicted by his or her intention (Ajzen, 1991). TPB focused on that intention affects human behavior, whereas attitude, subjective norm and perceived behavior control affect intention. Attitudes are the feelings of acts for likes or dislikes. Russell and William (2007) defined ‘subjective norm’ as “the summation of the similar relationship between the strength of one’s normative belief about the likelihood that important referent individuals or groups approve or disapprove of performing a given behavior and one’s motivation to comply with referents” (p. 1575). And finally, perceived behavioral control can be predicted by the summation of one’s control beliefs and one’s perceived power the act behavior (Russell & William, 2007). The framework of theory of planned behavior was used in this study to reveal the relationship between game playing intention and other factors, such as, attitudes, subjective norm, behavioral control, and parenting style.

**Research Hypotheses**

In order to explore the relationships between behavioral intentions, contingencies of self-worth, and parenting style; five major hypotheses were proposed to guide this research.

- **H1:** Self-worth will correlate with behavioral intention.
- **H2:** Behavioral control will correlate with behavioral intention.
- **H3:** Perceived attitude toward the behavior will correlate with behavioral intention.
- **H4:** Subjective norm will correlate with behavioral intention.
- **H5:** Parenting style will correlate with behavioral intention.

**‘To do or not to do’ Moral Game Design**

Lucas (2000b) indicated that applying complexity thinking to the world around us not only providing a difficulty to us but also giving us many new ways to think about questions and answers to the question, therefore, the hypothetic-deductive-evaluative model (Lucas, 2000a), the consequences-based normative moral problem solving technique (Hooker, 1996; Lucas, 2000a) is utilized for the game design (i.e. What happen-What you choose to do-What will happen next-What you will do next). This educational, interactive game ‘To do or not to do’ encourage players to consider what else would happen, what you should do, after you do what will happen, and what you will do next and so on. According to Allen (2003), hypothetico-deductivism postulates a theory of the phenomena in question in terms of a set of rules or postulates for obtaining theories, facts are not always observable, but rather by vision, accident or theories. Giving the same picture to two people, may get two different results. Furthermore, the evaluation system created in this game implies the behavior must be correct if the scores are to accord with the moral stages of Kohlberg (1984), otherwise, choice will be changed in next play.

The Model of Decision-Making Incorporating Ethical Values (Fritzsche, 1991) is the first to consider personal values as underlying “precedent of ethical behavior”. There are three important parts involving game design. First of all, we consider the model of decision-making behind ethic concept and why we should include values in Part 1 of game designing. By looking at what we actually mean by objectivity, and relate this to the subjective mind that creates such a concept, we develop reductive thinking using appropriate concepts to then show that ultimately ‘ought’ becomes appropriate, allowing players to solve the problem based on normative concepts. In Part 2, we examine what we mean by game scoring and look at what we must do to incorporate the values of Part 1 into the moral game. We outline the hypothetic-deductive-evaluative model (i.e. what happen – what you will do – after you do what will happen- what you will do next after that happen, and so on,) which brings the integrating ideas of complexity thinking into play in order to clarify moral value based upon meta-cognition. Lastly, in Part 3, we consider how we can use a game to make social choices in different situations, and allow us to regard conflicting values and contextual variation within a level of cognitive development.

When considering game scenario design, the problem solving model focused exclusively upon morality by Rest (1986) was adapted. Therefore, four psychological processes must occur prior to moral behavior: (1) interpret situation and create alternative actions; (2) choose alternative based upon considerations; (3) prioritize the moral value choice above amoral values and associate choice; and (4) intend to act. The game develop the moral reasoning ability by choosing the right ‘ought’ to the fulfillment of these needs and desires within a self-directing self. This game is free to make the choice from many alternatives while the self is restricted by concerns with inflicting harm on himself or herself, or other individuals, interfering on their rights. Through a developmental lens, we could gain insight into some common patterns for how children and adolescents develop
morally, and into issues of relevance for how children and adolescents define morality as well.

To explore whether moral reasoning develops in a predictable sequence, Kohlberg (1981, 1984) provided ‘hypothetical dilemma’ that often put the value of life against the value of one’ life to participants who were involving in his research. Kohlberg concluded that moral reasoning occurs in a sequence of three levels in which each level contained two stages. Kohlberg believed that every child started out at the pre-conventional level in terms of ego-centered considerations. The child focused on avoidance of punishment and obtainment of rewards (Stage 1) and then on satisfaction of self-interests (Stage 2). Then, the child go to group-centered considerations which the norms of family and other groups to which one belongs was focused (Stage 3), and social order was maintained (Stage 4). The third level, post-conventional level, goes beyond both the self and one’s society, the emphasis is on democratic procedure and social utility (Stage 5) or universal principles and individual rights (Stage 6).

METHOD
This study was conducted using a survey research design. The first step of the study design procedure was to develop a set of survey questions regarding self-worth, parenting style, and theory of planned behavior based on the review of document and literature. Second, the initial questionnaire was given to an expert panel to evaluate. Third, the revised pre-test questionnaire was given to the study sample before starting the game. Fourth, the post-test questionnaire was given to participants immediately after the game. Finally, Partial Least Squares (PLS) was used to measure the path relations of hypotheses.

Participants and settings
This study was conducted in four elementary schools in Taipei, Taiwan. The target population was made up of elementary students. The selection process in this study was a challenge, thus, a convenient sampling was used in this study. A total of one hundred and twelve 5th and 6th grade students (60 males and 52 females) from four elementary schools were invited to involve in this study. Their ages were around 10 to 12 years old; they have never played “To do or not to do” before; and most of them knew how to use computer. Each child was assigned a computer for playing the game.

Instrumentations
To develop an appropriate self-report instrument, the questionnaire of this study was derived from literature review, existing document, and other existing questionnaires by other researchers, such as Baumrind (1967), Crocker and Knight (2005), Crocker, Luhtanen, Cooper, and Bouvrett (2003), Lamborn, Mounts, Steinberg, and Dornbusch (1991), Sessa (1992), and Ajzen (1991).

1. Self-worth inventory
The first instrumentation of the questionnaire was a 13-item self-report inventory adapted from the studies of Crocker and Knight (2005), and Crocker et al. (2003). Participants were asked to rate the extent to which they strongly agree or strongly disagree with each item pertaining to beliefs regarding positive self-worth, and negative self-worth, by selecting one of five points on a Likert scale. This five-point scale read 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree.

Positive self-worth questions listed in the questionnaire, such as, Item 1 (When I feel I am attractive, I feel good about myself), Item 2 (Whenever I follow my moral values, self-satisfaction will be increased), and Item 3 (Knowing my academic performance is better than others, I feel good about myself). Negative self-worth questions, such as, Item 4 (Doing something wrong, I feel ashamed), Item 5 (If I can’t follow moral values, I could not respect myself), and Item 6 (If my academic performance is not good as expected, I feel bad about myself).

2. Parenting style inventory
The second instrument, adapted from the study done by Lamborn et al. (1991), and Sessa (1992), was a 3-item self-report measure. Students volunteers were asked to rate their beliefs associated with parenting style. Items are self-rated on a five-point Likert scale where 1=representive strongly restrict, and 5=strongly open.

Parenting style questions were related to parents’ attitude toward buying snacks (Item 14), and attitudes toward helping others voluntarily but causing me in a misunderstanding (Item 15), and attitudes toward caring about others but causing me in a misunderstanding (Item 16).

3. Theory of planned behavior inventory
The third inventory, in the post-post survey, was adapted from the study done by Ajzen (1991). It contained 5
items regarding perceived attitudes toward the behavior, 3 items regarding subjective norm, 3 items regarding behavioral control, and 4 items regarding behavioral intention. Participants were asked to rate these items on a 5-point scale where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree.

Item examples regarding the theory of planned behavior are provided as follows. Attitudes toward the behavior questions, such as, playing ‘To do or not to do’ make me feel happy. Subjective norm questions, such as, I play ‘To do or not to do’ because teacher’s request. Behavioral intention questions, such as, I will skip my dinner for playing ‘To do or not to do’ at home. And behavioral intention questions, such as, I will play the game all the time or whenever I can when the ‘To do or not to do’ competition is coming.

Procedure
After providing the explanations of the purpose of the study and the instructions of the ‘To do or not to do’ game to the participants, the volunteer student participants completed the self-report pre-test questionnaire regarding self-worth and parenting style before playing the game. All participants were invited to complete the post-test questionnaire associated with the theory of planned behavior such as attitude toward the game, subjective norm, and behavioral intention after playing the game.

DATA ANALYSES
Measurement model
We expected that each component of the pre- and post-test questionnaires except for background information section would make contributions to behavioral intentions. To test this idea, a confirmatory factor analysis was performed to examine the measurement model. The Partial Least Squares (PLS) method, one of Structural Equation Modeling (SEM), was chosen because it presumes no distributional form for measured variables, nor does it posits strong requirement on large sample sizes (Chin, 1998; Chin et al., 1996; Chin et al., 2003). The sample size of 112 was pass the recommended minimum of 40 for model testing (Wixom & Watson, 2001).

Reliability and validity of the survey
To ensure the content validity of the questionnaire, an expert panel including 10 people who are experts in this field was asked to evaluate the initial questionnaire developed based upon previous studies and literature review. The final questionnaire after the evaluation of the expert panel was administrated to study sample.

Beside the evaluation of an expert panel, the reliability and validity of the survey were assessed in several ways. According to Fornell and Larcker (1981), internal consistency can be assured by examining the composite reliability of the constructs; therefore, composite reliability was examined. Furthermore, Cronbach Alpha value was measured as well. Table 1 shows the results of composite reliability and Cronbach alpha values. All composite reliability values in this study ranged from 0.810 to 0.930, surpassing the suggested threshold value of 0.7 (Nunnally, 1978; Hair et al., 1998), though the alpha value was slightly below 0.7 in parenting style section, it is very close to 0.7, and as we will see later in this article, this parenting style section had adequate factor loading (greater than 0.5), therefore, no changes were made in parenting style section. Convergent validity in this study was evaluated by checking whether the factors loadings of each item are significant and greater than 0.5 (Nunally, 1978). In this study, the factors loadings ranged from 0.51 to 0.91 indicating acceptable convergent validity.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Composite Reliability</th>
<th>Cronbach Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative Self-Worth</td>
<td>0.84</td>
<td>0.78</td>
</tr>
<tr>
<td>Positive Self-Worth</td>
<td>0.83</td>
<td>0.74</td>
</tr>
<tr>
<td>Parenting style</td>
<td>0.81</td>
<td>0.65</td>
</tr>
<tr>
<td>Perceived attitude toward the behavior</td>
<td>0.93</td>
<td>0.91</td>
</tr>
<tr>
<td>Subjective Norm</td>
<td>0.89</td>
<td>0.82</td>
</tr>
<tr>
<td>Behavioral Control</td>
<td>0.89</td>
<td>0.80</td>
</tr>
<tr>
<td>Behavioral Intention</td>
<td>0.84</td>
<td>0.75</td>
</tr>
</tbody>
</table>

Last, to assess the discriminant validity, the square root of AVE of each construct was computed and compared with the correlation between constructs. In Table 2, all square roots of AVE were larger than the correlation coefficients between constructs, indicating that each construct was more closely related to its corresponding measurement items than to those of other constructs. This again supports the discriminant validity of the measures. In summary, the evidence showed good reliability and validity of the survey.
Table 2: Correlation Among Variables and Square Root of AVE

<table>
<thead>
<tr>
<th></th>
<th>Negative Self-Worth</th>
<th>Positive Self-Worth</th>
<th>Parenting</th>
<th>Perceived</th>
<th>Norm</th>
<th>Control</th>
<th>Intention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative Self-Worth</td>
<td>0.66</td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Positive Self-Worth</td>
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<td>0.67</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parenting</td>
<td>-0.01</td>
<td>-0.01</td>
<td>0.77</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived</td>
<td>0.05</td>
<td>0.10</td>
<td>-0.25</td>
<td>0.85</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Norm</td>
<td>0.05</td>
<td>0.11</td>
<td>0.27</td>
<td>-0.06</td>
<td>0.86</td>
<td></td>
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</tr>
<tr>
<td>Control</td>
<td>0.07</td>
<td>0.03</td>
<td>0.31</td>
<td>0.02</td>
<td>0.50</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>Intention</td>
<td>0.17</td>
<td>0.21</td>
<td>0.20</td>
<td>0.40</td>
<td>0.47</td>
<td>0.6</td>
<td>0.75</td>
</tr>
</tbody>
</table>

Structural model.
The test of the hypotheses involved estimation of the structural model’s path coefficients indicating the strength of the relationship between the dependent variable, independent variables, and the R-square values, which indicate the amount of variance explained by the independent variables. The study used the single-tailed t-test, and the criteria were as follows: *p < .05, t > 1.66; **p < .01, t > 2.36; ***p < .001, t > 3.37. The bootstrap re-sampling procedure was used to examine the stability of the Partial Least Squares (PLS) estimates (Chin, 1998). There were 111 re-samples. The structural model analysis was presented in Figure 1. The results showed all hypotheses were supported.

CONCLUSIONS
The present study was designed to use PLS to further investigate the relationship of behavioral intention, parenting style and the planned behavior. We had hypothesized that: (1) self-worth directly influences participants’ willingness to play our game; (2) behavioral control also influences participants’ willingness to play the game; (3) participants’ attitudes toward playing the game positively associated with their willingness to play the game; (4) participants’ subjective norm also positively associated with their willingness to play the game; and (5) participants’ willingness of playing the game develop as a direct result of parenting style.

The structural model testing indicated that all hypotheses were confirmed. (1) The path direction indicated that positive self-worth positively related to children’s willingness to play ‘To do or not to do’ (p=.13, t=2.24), and negative self-worth also related to their willingness to play the game (p=.10, t=1.71). (2) The result suggested that children’s behavioral control significantly influenced playing ‘To do or not to do’ intention (p=.46, t=5.83). (3) Children’s perceived attitudes toward playing ‘To do or not to do’ significantly influenced their playing intention (p=.40, t=7.18). (4) The subjective norms children possessed influenced their intention to play ‘To do
or not to do’ \((p=.21, t=2.31)\). (5) Parenting styles was investigated as one of factors influencing children’ intention to play ‘To do or not to do’ \((p=.11, t=1.89)\). Moreover, the result indicated that parenting style significantly influenced children’s subjective norms \((p=.27, t=3.12)\).

Briefly, the results indicated the self-worth, parenting style and theory of planned behavior measurements, factor loading were fit >0.5 and \(p\) values were <0.05 which fit in with research hypotheses referring to the behavioral intention was significantly influenced by behavioral control, self-worth, perceived attitude toward the game, subjective norm and parenting style. These results mirror the results of prior studies (Ajzen, 1991; Russell & William, 2007) regarding the theory of planned behavior, which reported that individual’s attitude, subjective norm, and behavior control affected individual’s intention. In addition, the results highlighted the importance of parenting style, which was consistent with earlier studies (Maccoby & Martin, 1983; Baumrind, 1989; 1991; 2005). Furthermore, subjective norm in this study was influenced by parenting style which in line with previous studies (Grusec, Goodnow, & Kuczynski, 2000; Lucas, 2000a) which proclaimed that children’s cognitive belief structure/ways of thinking can be influence by their parents.

According to the descriptive analyses, it is exciting to find out that majority of all students rated this game was interesting and would like to play it again. Interest has been seen as an emotion or an affective variable (Dai & Sternberg, 2004; Meyer & Turner, 2002), a powerful motivation to trigger participants to play. In this regard, the evidence of the descriptive analysis is especially revealing because it implies that interest to play the game has a positive influence on their choices to involve in the game again (Hidi & Renninger, 2006), this form of self-interest is one way to ensure that their interest will survive. Students could either play the game at home or school to learn moral education.

During the growth of moral development, people go through various different stages of moral development. Previous studies found that younger children often use the concepts from Stage 1 (avoidance of punishment and obtainment of rewards) and Stage 2 (satisfaction of self-interests) of moral development theory, while the concept of Stage 3 (belongings) became common among adolescence (Kohlberg, 1984; Snarey, 1985; Walker, 1989). This study was in line with the moral development theory, several evidences we saw were students were extremely excited when the demonstrations were offered to them, and eager to involve in the moral online game ‘To do or not to do’ which the punishments or rewards system was well-established to keep students remaining in the game.

Caution must used when interpreting the findings of the study and generalizing the results of the study due to the limitations related to internal validity. The first limitation was selection bias and sample size. Participants selected for this study from four different elementary schools in Taipei, Taiwan. Because of the limited access, the results of this study may have been influenced. In addition, participants in this study might not truly represent the populations in elementary schools. Caution must be used when generalizing the results of this research to children who did not involve in this study; however, the findings are applicable to those children involving in this study. The second limitation was the use of PLS can only test the relative path of the given causal model to the existing data set, thought the PLS results consistent with our hypotheses, longitudinal studies were encouraged. The third limitation might was instrumentation; participants may be affected by the wording or misunderstood the questions since these questions were adapted from English articles which could have influenced the results. The final limitation was the measures used in the present study largely emphasized the self-worth scales. Therefore, future studies should attempt to balance the content of each construct.

In summary, despite the shortcomings, the present study is consistent with previous work suggesting links among self-worth, parenting styles, and the planned behaviors. The next important step would be to conduct longitudinal studies to the structural model described in Figure 1.

**IMPLICATIONS AND FUTURE STUDY**

The major implication of the study is directed toward identifying ways to improve outcomes of e-learning or digital learning for students in Taiwan. The results of this study showed that participants like to play this online moral game which implied that attitudes or changes that needs to be occurred in either school or at home, (1) policy makers should consider setting up an e-learning classrooms where students and teachers enjoy e-service in each classroom, (2) school administrators, or teachers may put more emphasis on e-learning by providing a variety of e-learning, and interactive courses to vitalize the instruction, (3) other professionals who cares about education, such as, e-learning web site designer, could construct a variety of e-learning platforms to attract students.
This study is unique in that it is the first to explore whether factors, such as, self-worth, parenting style and planned behavior, influence children’s intention to play online moral game called ‘To do or not to do’ which created by digital game-based learning lab of National Taiwan Normal University, Taiwan. Thus, the online moral game itself is unique and may be useful to future researchers interested in a deeper understanding regarding e-learning issues. For example, the result did not tell us whether children’s game-based online learning experiences positively affect their outcome of academic regarding moral values or not. Thus much more research is needed in comparing the moral value learning outcome between face-to-face classroom and the online educational game, especially using ‘To do or not to do’.

The research approach used a quantitative research design. Interviewing a large pool of students or parents in a reasonable time frame would have proved difficult. Gathering a large data from parents regarding their parenting style would allow more in-depth analysis. Furthermore, gathering data from teachers who had used the ‘To do or not to do’ game in teaching moral education might be helpful to improve the study or the game we developed. Due to time restriction, and limited access, further research is needed to involve in different phases of students, and compare the similarities and differences on the planned behavior in either ‘To do or not to do’ game or other e-learning games, not only in Taipei, but in other counties of Taiwan. Improvements can be made to improve this research and hopes are that educators who work in e-learning area will consider this research for future study.

The researcher offers the following examples for future study: (1) Refine the survey instruments to identify new variables which might strengthen the analysis; (2) Broaden the scope of the research to different cities or counties to enhance understanding the influences that shape students’ decisions; (3) This study was limited to the scope of 5th and 6th students. It should be broaden to include multiple grade students in the study to gather a large pool of data for analysis; (4) Include teachers and parents in the study might be helpful to gather valuable data for analyses; (5) Research other influential factors such as student achievement. This would broaden the understanding the role of the game.

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EFL STUDENTS’ PERCEPTIONS OF LEARNING VOCABULARY IN A COMPUTER-SUPPORTED COLLABORATIVE ENVIRONMENT

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ABSTRACT

The present study was intended to explore EFL students’ perceptions of learning vocabulary collaboratively with computers. We recruited 91 eighth-graders from three intact classes in a junior high school in Taiwan, assigning one class to learning individually without computers, another learning collaboratively without computers and the other learning collaboratively with computers. All participants took a pretest before three sets of vocabulary exercises in three periods; after each set, they took an immediate posttest; and, a month after the experiment, all took a delayed posttest. The computer group also completed a questionnaire and six students were interviewed. The quantitative data showed that students, learning collaboratively with computers, were not outperformed in vocabulary tests designed for individual study; however, they showed better retention, outperforming the others in the delayed posttest. From the qualitative data, more than 70% of the participants in the computer group reported a positive attitude and anticipation to learning vocabulary in such an environment. A further analysis found the nature of tasks, sharing of computers and grouping effective to their approaches to learning. Finally this study agrees that success is not guaranteed but deliberate design needs to be considered before learners are engaged in a computer-supported collaborative learning environment.

Key Words: computer-supported collaborative learning, English vocabulary learning, learner perception

INTRODUCTION

Collaborative learning has been widely applied in education since 1980s for its positive effects such as enhancing motivation and critical thinking skills as well as improving academic performance and long-term retention (Brown, 2008; Dillenbourg, Baker, Blaye, & O’malley, 1996). During the collaborative learning process where social interdependence and interaction take place (Salomon & Globerson, 1989), interpersonal skills, positive attitudes towards group work, and social relationships are also developed. A number of researchers agreed that collaborative learning has its root in Piaget’s and Vygotsky’s learning theories that elucidate how cognitive development and learning takes place during collaborative activities, as noted by Brandon and Hollingshead (1999):

In Vygotskyian theory, learning occurs during interaction when students are exposed to a slightly higher level of difficulty than what they have already achieved cognitively. In Piagetian theory, learning occurs through interaction that produces multiple perspectives that, in turn, generate cognitive conflict in the individual student. (p. 117)

On the other hand, technology, whose applications have been widely used in language education, was found to increase learning motivation and interest, develop positive attitudes toward learning, result in higher-order thinking and better recall, as well as improve language skills (Stepp-Greany, 2002). The advance of technology has triggered its combination with collaborative learning and application in language classroom. It was assumed that this combination can bring about benefits from both sides. A number of studies advocating technology in

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support of collaborative learning revealed that the integration of computers into classrooms helps to increase collaborative behavior and social interaction among learners (Crook, 1994). Learning collaboratively in a technology-based environment was found to generate better learning effects than learning individually (Crook, 1994; Johnson & Johnson, 2004).

However, while technologies introduce a revolutionary classroom practice and human interaction, whether different technological applications have achieved equal degrees of pedagogical benefits in language teaching and learning is still questionable. Salaberry (2001), in a review study of technology use for second language learning and teaching, claimed that pedagogical effectiveness of different technologies is concerned with four major questions: (a) Is increased technological sophistication correlated to increased pedagogical effectiveness to achieve pedagogical objectives? (b) Which technical attributes specific to new technologies can be profitably exploited for pedagogical purposes? (c) How can new technologies be successfully integrated into the curriculum? (d) Do new technologies provide for an efficient use of human and material resources? (p. 51) These questions highlighted the importance of examining varying technologies separately in a particular instructional setting because pedagogical effectiveness lies in the way technologies are utilized and integrated into the curriculum (Salaberry, 2001; Zhao, 2003).

Computer-Supported Collaborative Learning
One of the emerging fields dealing with collaboration and technology in education is computer-supported collaborative learning (CSCL), a term first used by O'Malley and Scanlon in 1989 (Lipponen, Hakkarainen, & Paavola, 2004) and recognized by Koschmann as an emerging paradigm of educational technology in 1996. In reaction to the previous trend of designing computer programs centered on individual learners (Johnson & Johnson, 2004; Stahl, Koschmann, & Suthers, 2006), research of CSCL aims to explore how computers can be used to create an effective learning environment that supports collaboration in small groups (Koschmann, 1996; Stahl et al., 2006).

Although the bulk of previous studies has focused computer-supported collaborative learning on the use of network, which allows synchronous and asynchronous communication free of space limitation, the integration of technology and collaboration should not be exclusive to networking tasks or online communication at the expense of authentic face-to-face interaction where collaboration can also happen with the aid of computers (Stahl et al., 2006).

Despite of the seeming benefits of combining computers and collaboration, the CSCL issue should be tackled carefully in that both elements are involved with complex sub-issues (Stahl et al., 2006) that deserve further investigation. For example, Dillenbourg et al. (1996) indicated that factors, such as group size, group composition, nature of tasks, and communication media, may interact with one another in an intertwined way in which casual links can hardly be established between the learning conditions and effects of collaboration. Furthermore, studies under the label of CSCL involve a great variety in terms of methodological approaches, unambiguous definitions of CSCL, roles of computers, task types, learning goals, group composition, social interaction and instructional environments (Johnson & Johnson, 2004; Lipponen, 2002; Stahl et al., 2006; Strijbos, Kirschner, & Martens, 2004). Therefore, the effectiveness of CSCL should not be taken for granted without considering respective instructional settings where these variables interrelate (Strijbos et al., 2004), for fear of overgeneralizing the integration of technology into classrooms. In fact, not all studies with regard to technology-based collaborative learning reported satisfactory results in terms of group performance, interaction, and learning outcomes. Reflected upon the inconsistent findings, a number of researchers began to investigate some learner factors.

Learner Perceptions
One of the growing interests is aimed at understanding the learning process from a participant’s viewpoint (Koschmann, 1996). Although CSCL has been recognized as an important field in education since the mid-1990s, it was not until the 21st century did more CSCL researchers start to look into student perceptions of their learning experiences in a computer-supported collaborative environment. One of the latest studies conducted by Gomez, Wu, and Passerini in 2010 aims at investigating the relationship between students’ perceptions in different aspects. The finding revealed that perceived enjoyment of the computer-supported team-based learning is affected by perceived motivation and perceptions of team members’ contributions. Motivation has an impact on the relationship between team interactions and perceived learning. Those who perceive that their education benefits from the team interactions will better enjoy learning and experience higher-level learning outcomes.

Although not pointed out directly in CSCL studies, the relationship of perception-process-product seems to receive more attention in recent years. Since learners' perceptions of learning environments play vital roles in...
determining their approaches to learning during instructional processes (Biggs, 1993), studies investigating learning effects or outcomes should take these mediating factors into consideration. Although literature pertaining to learner perceptions has yielded similar results in support of implementation of collaborative learning or technology-based instruction in educational settings (e.g., Brown, 2008; Stepp-Greany, 2002), few studies have probed into learner perceptions towards technology-based, or computer-supported, collaborative learning. Some research also revealed discrepancy among learner perceptions when individual factors are considered. For instance, Smart and Cappel (2006) stated that the more experiences learners have with technology, the higher levels of their satisfaction in learning to use new technology are shown. There is also evidence that students’ personal computer proficiency is related to their perceived effect of computer technology to improve their learning (Keengwe, 2007).

Vocabulary Learning
The critical importance of vocabulary in all languages is undeniable because it not only establishes cognitive systems of knowledge, but also facilitates the communicative and comprehensive interaction (Coady & Huckin, 1997) as a base for affective and social relationship to build up. L2 vocabulary acquisition, unlike the incidental learning in L1, requires more efforts and time in learning target words intentionally. L2 learners, particularly in the early phase of L2 learning, need to reach the threshold level of frequent words in the target language for their languages skills and linguistic knowledge to develop (Nation, 1990, 1993, 2001). Effective vocabulary learning reflects in the useful retrieval of receptive and productive knowledge and requires deep processing that enhances long-term retention of vocabulary (Craik & Lockhart, 1972). Hence, lexical tasks and instruction should be designed with an aim to activate learners’ processing in depth and higher degree of involvement load (Hulstijn & Laufer, 2001). For example, students may profit more in acquiring unfamiliar words from CALL (computer-assisted language learning) software that offers sentence contexts, definitional or synonym cues, and optional word choices than from that which provides definitional information only (Kolich, 1991).

Purpose of the Study and Research Questions
The current study sets up a learning environment where learners collaborated to complete a series of vocabulary exercises on screen and attempts to account for the learning process and outcomes based on learners’ perceptions of their learning experience. Three main research questions are addressed in the study: (1) Are there any significant differences between the group of individual learning without computers, the group of collaborative learning without computers, and the group of collaborative learning with computers in vocabulary tests designed for individual study? (2) What are EFL high school students’ perceptions of learning vocabulary in a computer-supported collaborative environment?

METHOD
Participants
Three intact classes consisting of 91 eighth-graders in a junior high school in northern Taiwan were recruited. The three classes were randomly assigned to a group of learning individually without computers, another group of learning collaboratively without computers, and the other group of learning collaboratively with computers. Within the two collaborative groups, learners were grouped heterogeneously according to their academic performance in previous semesters. In each small group of each collaborative group, there were 4 to 5 students. Every student was assigned a specific role during the vocabulary exercise activity, including group leader, recorder/computer operator, timer, or checker/answerer. Students were able to discuss the role distribution with their group members and decided each person’s role.

Study Design
The independent variables in the study were treatments to different groups, that is, whether the participants learned independently or collaboratively; whether they used the computers during the learning process. Their vocabulary learning effects were the dependent variables we focused. To probe into how learners perceived their learning in a computer-supported collaborative environment, the computer group was separated for a qualitative investigation. The study design is shown in Figure 1 below.
Materials and Instruments
There were 5 sub-exercises for each set of vocabulary exercises: matching, filling in the blanks, spelling, unscrambling sentences, and crossword puzzle. An on-screen version with a different visual exposure was prepared for the computer group (see Figure 2 below). The vocabulary tests included one pretest in the form of a recognition checklist and two posttests, immediate and delayed ones, which were composed of recognition and production parts. The post questionnaire was designed to explore learners’ perceptions of learning in a computer-supported collaborative environment, with some open-ended questions included.

![Figure 2. Snapshots of vocabulary exercises](Clockwise from top left: matching, filling in the blanks, spelling, word puzzle and unscrambling sentences)

At the end of the study, a semi-structured interview was conducted to probe into learners’ perceptions towards their learning experience during the experiment and factors influencing their perception, participation, and performance. The questions included their general impression of the whole activity; their favorite, unfavorable, and the most helpful exercises; perceptions of the role assignment, participation, interaction, group composition, and group members during the collaborative process; the like or dislike of using computers in English class, perceptions of positive or negative effects of learning in such a collaborative environment; their anticipation and suggestion for similar activities in the future.

Procedures
Prior to the experiments, all participants first took a vocabulary pretest which measured their familiarity with the target words. The instructor then introduced target words to all participants in previous classes when teaching three individual lessons to which these words belong. The three groups then started to receive different treatments for vocabulary exercises in the following three weeks. In the control group, the participants completed each vocabulary exercise on a printed version individually without consulting other classmates, but they could refer to their own worksheet if needed. The participants in the experimental group without computers, also working on a printed version, needed to collaborate with their group members and finish the vocabulary exercises by discussing the answers. Those in the other experimental group with computers were asked to share computers in groups to complete the exercises on screen. The participants took an immediate posttest, consisting of 30 production and 30 recognition items, right after each set of vocabulary exercises to demonstrate their understanding of the word meaning in multiple-choice questions and the ability to actively recall a word in context and spell it correctly. After all the treatments ended, participants in the computer group were asked to complete a post-questionnaire with regard to their experiences of learning in such an environment. Four weeks after finishing the last set of vocabulary exercises, a delayed posttest was administered to all participants to measure their long-term retention of vocabulary. Six students in the computer group were selected for a later semi-structured interview. Data collected from the vocabulary tests, questionnaires, and interview were analyzed and compared quantitatively and qualitatively.

The vocabulary scores were first analyzed for descriptive statistics, with mean scores and standard deviation presented, to compare how the participants of each group performed in their individual achievement tests of vocabulary as a whole. Second, the scores were paired within each group and compared using paired-sample T-test to understand the vocabulary growth and forgetting rate. The differences of each score between the three groups were also analyzed using one-way ANOVA; the pretest, immediate posttest, immediate production, immediate recognition, delayed posttest, delayed production, and delayed recognition were involved. In addition to the respective scores, the study further probed into the immediate gain, delayed gain, and forgetting rate of each group. In addition to the vocabulary scores, the quantitative data in the post-questionnaire was analyzed descriptively in terms of frequency counts and percentages of respondents for each statement. The participants’ degree of agreement was not transformed to scores for fear that type I error may be induced because of the limited number of participants in the computer group.
RESULTS AND DISCUSSION
Ninety-one participants were recruited in the study, but 13 of them failed to participate in the whole data collection process and lacked scores of complete vocabulary tests or the post-questionnaire. Therefore, their data was not accepted for analysis. Only 78 participants were included.

Learning Vocabulary Collaboratively with Computers
The result of mean scores and standard deviations of the vocabulary tests is presented in Table 1, showing a sharp increase in both gain and retention.

Table 1: Scores of pretest, immediate posttest, and delayed posttest

<table>
<thead>
<tr>
<th>Group</th>
<th>Pretest (30)</th>
<th>Immediate posttest (60)</th>
<th>Delayed posttest (60)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Individual learning without computers</td>
<td>27</td>
<td>.78</td>
<td>1.761</td>
</tr>
<tr>
<td>Collaborative learning without computers</td>
<td>26</td>
<td>.81</td>
<td>1.132</td>
</tr>
<tr>
<td>Collaborative learning with computers</td>
<td>25</td>
<td>1.24</td>
<td>2.314</td>
</tr>
<tr>
<td>Total</td>
<td>78</td>
<td>.94</td>
<td>1.783</td>
</tr>
</tbody>
</table>

The pretest, a recognition checklist of 30 target words, showed that participants were unfamiliar with these words, getting only .94 out of 30 on average. The immediate posttest and delayed posttest required participants to recognize the target words in the form of 30 multiple-choice questions and fill words in the blank based on contextual hints. The group learning collaboratively without computers scored the lowest in both posttests. The group learning individually without computers scored the highest in the immediate posttest, whereas the group learning collaboratively with computers scored highest in the delayed posttest.

According to the paired-sample t-test, as presented in Table 2, vocabulary growth within each group from the pretest to the immediate posttest, which was examined in terms of production and recognition sections, was significant, so was the difference between the pretest and the delayed posttest. Nevertheless, the rate of forgetting in each group was also found to reach a significant level .000 (p<.01), as indicated by the 5th, 6th, and 7th pair between immediate posttest and delayed posttest. Participants forgot much of the vocabulary in the delayed posttest, but the vocabulary gain compared with the pretest was still significant.

Table 2: Paired-sample t-test in each of the three groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Individual learning without computers</th>
<th>Collaborative learning without computers</th>
<th>Collaborative learning with computers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1 Pre-ImPro</td>
<td>-6.940**</td>
<td>-4.950**</td>
<td>-7.143**</td>
</tr>
<tr>
<td>Pair 2 Pre-ImRec</td>
<td>-31.588**</td>
<td>-26.804**</td>
<td>-18.775**</td>
</tr>
<tr>
<td>Pair 3 Pre-DePro</td>
<td>-3.543***</td>
<td>-3.352***</td>
<td>-3.253***</td>
</tr>
<tr>
<td>Pair 4 Pre-DeRec</td>
<td>-16.201**</td>
<td>-13.948**</td>
<td>-12.125**</td>
</tr>
<tr>
<td>Pair 5 ImPro-DePro</td>
<td>6.122***</td>
<td>5.396**</td>
<td>5.894**</td>
</tr>
<tr>
<td>Pair 6 ImRec-DeRec</td>
<td>6.619**</td>
<td>6.143**</td>
<td>4.878**</td>
</tr>
<tr>
<td>Pair 7 ImPost-DePost</td>
<td>9.760**</td>
<td>9.360**</td>
<td>6.851**</td>
</tr>
</tbody>
</table>

Note. Pre=pretest, ImPro=immediate production, ImRec=immediate recognition, DePro=delayed production, DeRec=delayed recognition, ImPost=immediate posttest, DePost=delayed posttest; **p<.01

The results of one-way ANOVA on the vocabulary tests designed for individual study indicated that vocabulary scores of the pretest (F (2, 75)=.531, p=.590), immediate posttest (F (2, 75)=1.094, p=.340), and delayed posttest (F (2, 75)=.288, p=.751) were not significantly different between the three groups, so were the differences of immediate gain (F (2, 75)=1.396, p=.254), delayed gain (F (2, 75)=.290, p=.749), and forgetting rate (F (2, 75)=2.765, p=.069). The vocabulary exercises appeared to assist participants in acquiring vocabulary; the treatment of computers and collaboration did not influence the vocabulary scores to a significant extent, which could be attributed to the task type itself. Since vocabulary learning requires more individual effort than collaborative contribution, it is conceivable that the difference would be minor if the vocabulary exercises were identical. Nevertheless, it was interesting to find that while the group of individual learning without computers outperformed the other groups in the immediate posttest and acquired more words, the participants in this group seemed to have higher rate of forgetting, with an average mean 15.11 (SD=8.045) that was lower than scores in
Vocabulary learning is considered a more individual task rather than a collaborative one; the three vocabulary tests are also designed so in mind. It is, therefore, reasonable that the participants in the group of individual learning without computers performed better in the vocabulary tests, an assessment that emphasizes individual learning effects. However, as seen in the statistics above, learning collaboratively seems to help learners remember vocabulary longer and forget less over a period of time despite of the individual-oriented exercises and assessment. In addition, with the aid of technology, or computers in the current study, learners appeared to have a better long-term retention.

**Positive Attitudes Towards Learning in a Computer-Supported Collaborative Environment**

To answer research questions 2, the current study examined participants’ responses to the post-questionnaire and the semi-structured interview, which were designed to explore their perceptions of learning vocabulary in a computer-supported collaborative environment, and attempted to offer an explanation for the vocabulary learning results. Table 3 presents the results of participants’ responses to the post-questionnaire.

<table>
<thead>
<tr>
<th>Statement</th>
<th>SD</th>
<th>D</th>
<th>N</th>
<th>%</th>
<th>A</th>
<th>%</th>
<th>SA</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I like to learn English with the use of computer technology in English class.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>36</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>2. I think activities through computer technology can help me in learning English.</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>8</td>
<td>9</td>
<td>36</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>3. I think using computer technology in English class can enhance my interest in learning English.</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>6</td>
<td>24</td>
<td>12</td>
<td>48</td>
</tr>
<tr>
<td>4. I think collaboration in group work is more required to complete an activity when computer technology is used in English class.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>40</td>
<td>8</td>
<td>32</td>
</tr>
<tr>
<td>5. I think group work activity with the use of computer technology is more efficient through collaboration.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>36</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>6. I think only one or two members are enough to take the responsibility to finish the group work activity with computer technology.</td>
<td>5</td>
<td>20</td>
<td>6</td>
<td>24</td>
<td>13</td>
<td>52</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>7. I hope I can operate one computer by myself when using computer technology in English class.</td>
<td>5</td>
<td>20</td>
<td>3</td>
<td>12</td>
<td>8</td>
<td>32</td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td>8. I think doing vocabulary exercises through computer technology are more interesting than doing identical exercises of printed version.</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>8</td>
<td>32</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>9. I think vocabulary exercises through computer technology enhance my memory for English vocabulary.</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>8</td>
<td>14</td>
<td>56</td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td>10. I think doing vocabulary exercises through computer technology would distract me from the English words.</td>
<td>7</td>
<td>28</td>
<td>7</td>
<td>28</td>
<td>10</td>
<td>40</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>11. I think learning English with the use of computer technology is suitable for me.</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>14</td>
<td>56</td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td>12. I am looking forward to the future opportunity of using computer technology in English class.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>28</td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td>13. I think learning English with the use of computer technology is suitable for me.</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>20</td>
<td>8</td>
<td>32</td>
</tr>
</tbody>
</table>

When asked about the perceived relationship of technology use and English learning, 64% of the participants claimed that they like to learn with the use of computer technology in English class, without any negative attitude reported from the rest. Eighteen students (72%) claimed that the use of computer enhanced their interest in learning English, while only one student showed less interest in learning with computers. With regard to collaborative learning, while more than 60% of the participants were aware of the importance of collaboration in a group and agreed that group work activity with the use of computer technology is more efficient through
collaboration, not all of the students were able to play their individual role well. Instead, arguments were easily raised at times with respect to operation of computers. Those who were assigned less influential roles, such as timer or recorder, had a tendency to be distracted from the task. In other words, they were not so attentive to the target words appearing in the exercises, compared with those in the individual group exposed to almost every target word. This was considered a chief reason why the computer group did not outperform in the immediate posttest. Compared with the printed version of vocabulary exercises, the on-screen version appealed to 64% respondents who found it more interesting to do the exercises through computers. Only one participant showed disfavor for doing on-screen exercises. While 56% of the participants were uncertain about the helpfulness of computer use in enhancing their memory of English vocabulary, 36% of the rest agreed to have better retention when learning with computers and only 8% had an opposite view. More than half (56%) of the students disagreed that they would be distracted from target vocabulary because of the computer, while only one participant reported the possibility of distraction. The rest 40% respondents neither agreed nor disagreed with the situation. When it comes to the whole learning experience in a computer-supported collaborative environment, 40% of the students agreed that the learning way is suitable for them, whereas only one student had no preference for the use of computer in English class. More than half (56%) of the participants, nevertheless, expressed an uncertain attitude towards the suitability of computer use for them. Despite of the uncertainty, up to 72% of them were looking forward to the future opportunity of using computer technology in English class. Generally, 76% of the participants felt satisfied with the experience of learning English vocabulary in a computer-supported collaborative learning environment. Twenty percent of the rest held a neutral view and only 4% showed dissatisfaction.

The open-ended questions included in the post-questionnaire were concerned with participants’ favorite and most unfavorable part of the whole learning experience. The qualitative data revealed that most participants were fond of the use of computer in their English class because it was fun and different from the traditional way of learning; it was more time-saving than doing paper-and-pencil exercises. They enjoyed the playful effect of operating computers, which also allowed them to improve the computer literacy like keying in words. Besides, some students claimed to favor the variety of exercises in which they encountered target words repeatedly, but they seemed to have preferences for different subtasks. Each kind of exercise has been mentioned as the favorite by students of different learning needs and focus. In addition to the use of computer and variety of exercises, a few students mentioned the collaborative experience as their favorite. The major reason was the chance of discussing with others and working together to complete a task. Other respondents pointed out that collaboration improved the relationship between group members, led to better efficiency during the activity, and enhanced the impression of learned materials and interest in learning English. On the contrary, the most unfavorable part reported by participants included specific tasks which they could hardly complete in time or they considered too challenging, such as the fill-in-the-blank and unscrambling sentences. In spite of the different task content, one student felt bored with the repetitive framework of exercises after doing three sets. A number of students complained that sharing of computers resulted in collaborative and communicative problems when every group member attempted a chance to operate the shared computer. Those who were not given the chance to operate the computer tended to withdraw attention from the whole learning activity. In addition to task and grouping problems, some students were unsatisfied with the interface of the computer software, complaining that the answering square was difficult to move on screen such as exercises of matching and unscrambling sentences. The selected interviewees’ responses to the semi-structured interview reflected findings in the post-questionnaire. Participants enjoyed the learning experience in a computer-supported collaborative environment in that computers aroused their interest and motivation to learn as well as participate in the learning activity. It was reported that working in a group enabled them to discuss and exchange opinions with others. During the collaborative process, the major concerns were sharing of computer and assignment of roles, both of which made it difficult to involve everyone fairly in learning tasks and vocabulary exposure. According to the interviewees, the group composition still had an effect on their participation. Most of them preferred grouping by themselves while still others like the heterogeneous grouping by the instructor to avoid possible arguments resulted from self-grouping.

Obviously, the use of computers can attract and motivate learners to participate in the group tasks and learning activities, but only half of the participants agreed that they benefited from the computer technology in learning English. The main reason may result from the task itself, the sharing of computer, and role assignment during the collaborative process. Since computers were attracted to almost all participants, none of whom expressed negative attitude, everyone was looking forward to operate the computer. The vocabulary tasks in the current study required less collaborative work, which caused possibility of attention dispersion of certain learners. Not all team members, for example, exerted equal mental effort on given tasks (Salomon & Globerson, 1989). This uneven student participation may result from different learner perception of their roles and relationship with other members in a group, and have an effect on the collaborative process as well as the team performance, leading to
some debilitating effects derived from social loafing, free-riding, or differential status. Although participants were asked to take the partial responsibility of each task, some group members tended to hide themselves once they were aware of the more proficient ones who would take care of the task, especially when the tasks were more disjunctive (Kerr & Bruun, 1983), in which the group performance depends on how well the most talented member does. Reflected upon the qualitative data, learners’ perceptions with regard to the group composition (Graf & Bekele, 2006; Johnson & Johnson, 2004), nature of tasks, and individual accountability appeared to have an effect on learning approaches they adopted.

The current results suggested that long-term retention of vocabulary was highly related to the depth of involvement and deep processing during the learning process. In the collaborative group with computers, the learners motivated by the use of computers were engaged more in their learning with a deeper level of involvement load (Hulstijn & Laufer, 2001). This may account for their better performance in the delayed posttest than the other two groups without computers. Within this computer group, nevertheless, those who considered themselves having little access to the computers tended to withdraw from the learning task and thus gave much less attention needed for deep processing, lacking elaboration of mental representation (Hulstijn, 2001).

CONCLUSION

The present study, by means of both qualitative and quantitative research methods, probed into the relationships between learner perceptions, learning process, and learning outcomes in a computer-supported collaborative environment. Our participants showed great acceptance and interest in learning in such an environment, but the collaborative process was not as ideal as expected. As reflected in learners’ perceptions, regardless of the role assignment to each group member, positive interdependence and individual accountability that were required in successful collaborative learning have not been well achieved in the current study. This unsatisfactory result may be attributed to the task, in which some members’ efforts may be considered dispensable. Nevertheless, despite the fact that the task was hardly a collaborative project, the forgetting rate of vocabulary revealed that the two collaborative groups were able to retain the target vocabulary longer. Furthermore, of the two collaborative groups, the computer group even forgot less than the group without computers in the delayed posttest. This finding suggested that the combination of technology and collaboration in language learning had a long-term effect even though the task was not so collaboration-oriented. The significance of the study was limited due to the number of participants and study span. Therefore, it is suggested that future study be conducted with a greater number of participants and for a longer time span to know whether the effect of CSCL can be extended to other learning aspects. Finally, this study concludes that success of combining collaboration and technology is not guaranteed, but factors like group composition and task types need to be considered before learners are engaged in a computer-supported collaborative learning environment.

REFERENCES


EMERGING INNOVATIVE TEACHER EDUCATION FROM SITUATED COGNITION IN A WEB-BASED ENVIRONMENT

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ABSTRACT
In this paper, the authors first discuss the main rationales of situated cognition and its connections with innovation in teacher education. The challenges that might occur in applying situated cognition in teacher education programs, including insufficient opportunities for cognition apprenticeship, limited social interactions, and constraints in microteaching, are then presented. Correspondingly, this paper suggests three principles—enhancing peripheral participation, strengthening cognitive apprenticeship, and forming special interest groups online—in order to integrate situated cognition with a Web-based environment as a way to overcome the defects of conventional teacher education programs. Further, a recent application trial is described as a demonstration of how to innovate teacher education using a Web-based environment. Finally, a group of pre-service teachers participated in the research, and their perceived usefulness of the Web-based environment were measured and discussed. The results substantiate the applicable principles to establish a Web-based environment to support the course in teacher education. These outcomes are believed to contribute to both teacher education and educational technologies in the contemporary milieu of education.

Keywords: Situated cognition, Teacher education, Web-based learning environment, Pre-service teacher

INTRODUCTION
Many teacher educators emphasize the idea that situated cognition can bring benefits in improving career competence (Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991; McLellan, 1996). According to this notion, the theory of situated cognition is appropriate for depicting pre-service teachers’ professional development in teacher education. Practical experience is especially accentuated as a way to enrich these trainees’ cognition in an authentic teaching context. It is, hence, suggested that pre-service teachers need a teacher education program that provides not only pedagogical knowledge but also teaching experience. In other words, pre-service teachers can better improve their teaching competence in an authentic classroom setting. In an authentic teaching context, being apprentices of experienced teachers can give them a real understanding of what successful teaching is. In this context, pre-service teachers can observe, imitate, explore, and reorganize the ideas that they have formulated about teaching. The role of the teacher education program will, thus, not be that of a teaching resource presenter; rather, it will be that of an opportunity provider that serves to enhance the growth of pre-service teachers’ knowledge about teaching. In teacher education program, pre-service teachers cannot wait until they graduate and become in-service teachers to acquire authentic teaching experience. Therefore, teacher educators at the university level still need to seek innovative ways to implement programs that provide practical teaching experience for pre-service teachers.

In recent decades, the application of information and communication technology (ICT) has brought a great impact and created a new paradigm in education. Among ICT applications, the World Wide Web (WWW), in particular, has contributed to developments in educational enterprise (Brooks, 1997). Teacher education should not be concerned only with improving the competence of pre-service teachers in using ICT; more importantly, it should be concerned with whether innovation can be brought to conventional teacher education programs through the use of a Web-based environment. In conventional teacher education, teaching practice is thought of...
as the most important part of preparing a teacher for his or her career. Before becoming interns, pre-service teachers will utilize all of the knowledge that they have acquired to attain the experience of being a teacher in a “real” classroom context. In university, teacher educators and mentors (invited experienced in-service teachers) both play essential roles at this stage in nurturing pre-service teachers’ professional development.

When it comes to improving pre-service teachers’ teaching with ICT, there are several limitations in applying situated cognition. First, even though the mentors are experienced teachers, this does not guarantee that they are familiar with or interested in teaching with ICT. Second, pre-service teachers cannot observe or experience authentic teaching with ICT in secondary schools because of a lack of hardware, software, and administrative support. Third, teacher educators tend to focus more on conventional teaching techniques, such as the organization of teaching materials or classroom management. The demonstration and discussion of teaching with ICT is comparatively compressed in the course design of teacher education programs. In this situation, pre-service teachers have relatively few opportunities to enrich their experience of teaching with ICT or to verify the ideas that they might have about teaching with ICT. Ultimately, this diminishes the possibility of developing competence to cope with modern teaching demands. As a result, the application of situated cognition in teacher education should be carefully examined and revised from the original thesis. With a proper design, ICT can offer teacher educators more opportunities to establish a learning environment that can effectively nourish the teaching competence of pre-service teachers. The purpose of this study is to propose principles to establish a Web-based environment that support teacher education via the rationale of situated cognition. In order to substantiate the feasibility of the principles, this study intended to answer following research questions:

1. How do the pre-service teachers perform teaching practice in a Web-based environment that emerged from situated cognition?
2. How do pre-service teachers perceive the usefulness of a Web-based environment applied in teacher education course?

LITERATURE REVIEW
Challenges in Incorporating Situated Cognition into Teacher Education
The main philosophy of situated cognition is the idea that knowledge is situated in an authentic context and that learning is an actively cognizing process that interacts with this context (Brown et al., 1989). The rationale of situated cognition implies a way to interpret how pre-service teachers nurture their teaching competence in teacher education. However, there are still challenges in applying situated cognition in conventional teacher education, and these will also inevitably emerge when teacher education programs innovate. The challenges are reviewed in the following sections.

Insufficient Cognition Apprenticeship in Instructional Design
Instructional design is the first step that a teacher engages in in the practice of teaching. However, such design is a complex undertaking consisting of several kinds of teaching activities, including: (1) analysis of students’ needs; (2) knowing the goals of teaching development; (3) making decisions about teaching content; (4) arranging teaching procedures; and (5) evaluating the effects of teaching (Bennett, 1997). Pre-service teachers usually lack authentic teaching experience even though they may have acquired content knowledge and pedagogical knowledge. Without proper guidance or training, pre-service teachers will utilize past experiences in the classroom to imagine how their teaching will take shape. Many factors that will influence the quality of their teaching are ignored, such as students’ prior knowledge, proper teaching models, or reliable representation. A successful teacher education program will concentrate on the benefits that instructional design activities can offer (Hacker & Niederhauser, 2000; Niederhauser & Stoddart, 2001). Teacher educators and mentors will utilize what they have gained from their professional experience to offer comments on pre-service teachers’ instructional design, such as the design of lesson plans. In conventional teacher education programs, this is a way of enhancing pre-service teachers’ cognition apprenticeship. Pre-service teachers’ competence with regard to teaching practice is also nurtured in this way, but ideal cognition apprenticeship is not easy to accomplish in a traditional classroom setting, even in a university. The number of pre-service teachers is far larger than the number of teacher educators. In most cases, there are 10-20 pre-service teachers in a program, but only one or two teacher educators support pre-service teachers’ instructional design. Considering the limited time and effort that is possible, teacher educators’ guidance might be diminished and insufficient. It seems that educators need a more effective means for the support of cognition apprenticeship in training pre-service teachers.

Limited Social Interactions within the Community
Social interactions are suggested as a way to promote members’ professional development in a community
composed of pre-service teachers and teacher educators (Smylie, Allensworth, Greenberg, Harris, & Luppescu, 2001; Schlager, Fusco, & Schank, 2002). Such interactions are also treasured resources for bringing about reforms in teaching. In teacher education programs, a seminar form of discussion is usually used to enhance interactions in the community. Pre-service teachers have the opportunity to present what they have learned from the activities of the program, which would include observation of teaching, teaching preparation, and engaging in teaching. However, oral interaction in a class has its natural drawbacks. The interactions can only occur in class, and discussions about any particular teaching issue might attract only a limited number of members. These interactions might be quickly wiped from their memories. As a result, the benefits and opportunities of joining in such discussions are uneven or unfairly distributed. This will weaken the function of social interactions within the community for learning how to teach. Further, members of the community are unlikely to share a repertoire that can support professional development. As a result, the second challenge is the limitation of social interactions among the members of the teacher education community.

Constraints in Microteaching
Microteaching was proposed by Allen and Ryan (1969), and the idea is widely accepted in the field of teacher education. It can be described as a scaled-down and simulated teaching activity in a teacher education program. Microteaching is usually conducted with simple concepts or in a single class hour in a university as a teaching trial, not in an actual elementary or high school setting. Before pre-service teachers become interns, microteaching helps them to mature by gaining teaching experience. Microteaching is a decisive opportunity for pre-service teachers to prepare themselves for teaching successfully after they graduate from the teacher education program. The students in a microteaching course are the peers of the pre-service teacher who is performing the microteaching. During such activity, pre-service teachers are expected to draw on the teaching knowledge that they have acquired, including knowledge for practice, knowledge in practice, and knowledge of practice (Cochran-Smith & Lytle, 1999). Since the process is different from observing other teachers and from imagining what should be taught, pre-service teachers involved in microteaching can directly engage in teaching activities. Hence, microteaching can be treated as a core practice in a community of teaching practice. If the pre-service teachers can successfully complete the activity, they can be on their way toward full participation in the community of practice. Their performance in microteaching is also an indicator that can be used to evaluate whether pre-service teachers are well-prepared for actual teaching. For most pre-service teachers, microteaching is a new experience. They are expected to spend considerable quantities of time and effort to accomplish the activity. Thus, it is not possible for them to perform microteaching too often during a semester. In other words, the opportunities they have to try out different teaching contents, methods, and representations are diminished. Further, teaching with ICT in a traditional classroom setting is naturally limited (Rodrigues, Marks, & Steel, 2003). This also limits pre-service teachers’ experience in teaching and utilizing ICT in the classroom.

Facing these challenges, teacher educators need to find ways to overcome them and further improve pre-service teachers’ professional development in the contemporary era of ICT. In the current study, the authors proposed a rationale to derive innovative teacher education from situated cognition and established a Web-based environment to accomplish the aim of enhancing pre-service science teachers’ teaching competence.

METHODOLOGY
This study aims to know how the pre-service teachers perform teaching practice in a Web-based environment and to reveal how they perceive the usefulness of such an innovative teacher education program via a survey. The research participants, context, data collection, and analysis are described in the following sections.

Participants
This study invited 29 pre-service teachers as participants. All of these participants were majoring in biology. 23 of them were undergraduate students, and the other 6 were graduate students. When the study was conducted, all of the participants were in the last year before graduating from the university and becoming teacher interns. In the authors’ nation, they had to complete a one-year-long course titled Science Teaching Practice before graduating from teacher education program in the university in order to become teacher interns. The pre-service teachers seldom have teaching experiences prior to becoming teacher interns in middle schools. They were expected to organize what they have learned at the university, both content knowledge and pedagogical knowledge, to fulfill the learning goal of the Science Teaching Practice course.

Description of the Research Context
In this study, the authors proposed three principles to innovate a teacher education program in which pre-service teachers can be trained in a manner that fits better with a situated cognition rationale. The principles are shown
in Table 1, including enhancing peripheral participation, strengthening cognitive apprenticeship, and forming special interest groups online. Based on the principles, a Web site denominated as Technology Enhanced & Assisted Curriculum Headquarter (TEACH) was established in accordance with our approach and applied to provide support to the pre-service teachers taking part in the course activities of teacher education and facing the challenges discussed in previous sections. Pre-service teachers were then expected to transform their teacher knowledge in a more mature and profitable manner by participating in and working with TEACH. The following sections will indicate how the three proposed principles are applicable in TEACH.

Table 1. Principles to innovate a teacher education program with the situated cognition rationale

<table>
<thead>
<tr>
<th>Principles</th>
<th>Support provided by TEACH</th>
<th>Challenge to be overcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhancing peripheral participation</td>
<td>Stepwise guidance for designing lesson plans; automatic transformation of lesson plans to online course arrangements; shared repertoire database</td>
<td>Insufficient cognition apprenticeship</td>
</tr>
<tr>
<td>Strengthening cognitive apprenticeship</td>
<td>Embedded expert knowledge in guiding procedures for designing lesson plans; virtual implementation of online courses; online review system for lesson plans and online courses</td>
<td>Limited social interactions</td>
</tr>
<tr>
<td>Forming special interest groups online</td>
<td>Course-wide discussion forum to support additional social interaction</td>
<td>Constraints in microteaching</td>
</tr>
</tbody>
</table>

Enhancing peripheral participation

According to the rationale of situated cognition, learners shall form, modify, and construct their own knowledge through a process of observation, imitation, and practice (Lave & Wenger, 1991; McLallan, 1996; Schlager & Fusco, 2003). These processes are described as “legitimate peripheral participation” in a community aimed at learning. A learner can achieve the goal of learning when his or her participation status successfully shifts from the peripheral to the core of the community. That is to say, inexperienced learners can eventually possess expertise with effective participation in a community of mutual practices. As the pre-service teachers engage in teacher education program, the community comprised by these trainees, experienced school teachers, and teacher educators naturally attempt to provide potentially sufficient opportunities to make the procedures of participation explicit. However, this does not guarantee pre-service teachers’ efficient participation with their limited course hours in the conventional learning environment. In order to improve the current teacher education course’s fit with the situated cognition rationale, this study incorporate TEACH into the course and integrate the following functional support within it:

(a) Stepwise guidance for lesson plan design. TEACH provided a stepwise authoring system for designing lesson plans. Pre-service teachers can start their teaching practice from such design work. In this authoring system, pre-service teachers are asked to fill out sequenced forms (see Figure 1) to conceive each part of a
lesson plan, including teaching topic, goals, teaching model, teaching equipment, learning activities, and assessment, as well as to arrange them in a flow chart to show the sequence of design work. In the sequenced procedure, the system will provide relevant hints and explicit prompts in each design stage. For example, in the stage of deciding on the teaching topic, the system will show related concepts and national standards that are relevant to the teaching topic selected by the pre-service teacher. After completing the lesson plan designs, the authoring system automatically generates a Web page-based lesson plan. The designed lesson plans are an individual’s artifacts and stored in a personalized space in TEACH. Furthermore, if pre-service teachers add multi-media files as teaching materials, these materials can be hyperlinked into the lesson plan and easily retrieved.

(b) Automatic transformation from lesson plan to online course arrangement. TEACH provides another authoring system for creating online courses based on the lesson plan. While the pre-service teachers complete the lesson plan design on TEACH, they can decide whether to create online courses based on their lesson plans. If so, TEACH can automatically analyze their lesson plans and break the teaching process into several “nodes of teaching” in a tree map form. Pre-service teachers can continue to design online course activities by adding the instructional modules that refer to the nodes of teaching. The instructional modules offered by TEACH include tutoring, online notebooks, forums, assignments, tests, and concept maps. With these modules, the pre-service teachers can easily generate Web-based courses with a tree map structure, as shown in Figure 2. This authoring system requires neither programming nor Web page design abilities. Pre-service teachers can design online courses directly without preparing lesson plans first on TEACH if they wish.
Shared repertoire database. When pre-service teachers engage in designing instructional activities online, they need many teaching resources to support their design works. Such teaching resources include video clips, still pictures, sounds, JAVA simulation, Flash animations, and concept maps. In addition, the lesson plan and online course that described in previous section also comprise a part profitable teaching resources. Pre-service teachers can decide whether to share their own teaching resources with other users in TEACH. When pre-service teachers contribute these teaching resources to the community, they are asked to provide tags and descriptions. Such information can support the construction of a shared repertoire database and function as searching index. As a result, the shared repertoire not only attracts pre-service teachers' interest in retrieving useful resources but also provides them with opportunities to deliberate peers’ intention to use such resources in teaching design.

Since the functional support provides the pre-service teachers with increased experiences in instructional design and sharing repertoire, the preparation of teaching in TEACH affords extra opportunities outside of the conventional classroom context to enhance these trainees’ peripheral participation. With peripheral participation in teaching practice, pre-service teachers are guided to engage in a consecutive learning process that fits with the situated cognition rationale.

Strengthening cognitive apprenticeship

The term ‘cognitive apprenticeship’ refers to a learning process in which a master tutors her/his apprenticeship in competence. In the field of education, cognitive apprenticeship is particularly emphasized in expert preparation. The rationale specifically concentrates on learners’ nurturing professional competence. Inexperienced apprentices learn through a process of internalizing what they have perceived from experts who possess proficient literacy and are able to perform skillful career work. For teachers, instruction is also a dexterous employment that depends on their professional knowledge and competence. This undoubtedly leads to the idea that teacher education is under a similar situation in nurturing pre-service teachers to become “experts” of instruction. Cognitive apprenticeship is, then, proper to include in explaining the relationship between teacher educators and pre-service teachers in current teacher education.

However, it is not easy to fulfill all individuals’ learning needs in a conventional teacher education course because of the limited ratio of teacher educators to pre-service teachers. This is a key point, as a Web-based agent can provide support and be what the authors expected to accomplish in TEACH as a supplement. Hence, the authors arranged the following functionalities to strengthen apprenticeship in teacher education via TEACH. First, a great deal of teacher knowledge and instruction-related information are embedded in the design procedure in TEACH. For instance, when pre-service teachers conduct design work for lesson plans, TEACH provides specific guidance in accordance with their chosen specific teaching model. As shown in Table 2, the TEL model (Hsu, 2008; Hsu, Wu, & Huang, 2008) is one of the built-in teaching models. As the pre-service teachers decide to design a lesson plan based upon the TEL model in TEACH, s/he shall acquire prompts from the system in different stages of design. After the design work, a real-time checklist pops up for pre-service teachers to examine whether her/his design fits in with the construct of the TEL model. In these sequenced procedures, pre-service teachers can not only get acquainted with instructional design but also obtain
opportunities for them to reflect the nexus between learning theory and instructional design. Further, they can also consult with teacher educators to discuss why these teaching models can contribute to their teaching competence. Second, the design and implementation of online courses provide a vision for pre-service teachers to deliberate the possibilities of carrying out teaching using Web-based technologies. As the online course is under way, the pre-service teachers will have a teacher identity that they can use to conduct the learning activities in the course and to recruit students to participate in the course through the student interface. Compared to conventional microteaching, online courses will increase the pre-service teachers’ experience in conducting teaching with ICT and reduce the time loading of their peers (other pre-service teachers) and teacher educators. Being online, the virtual “students” might not be restricted only to their peers, so that pre-service teachers can, thus, get more useful comments from a broader audience. Third, an online review system is built into TEACH for teacher educators to provide comments and suggestions directly on the Web page-based artifacts of pre-service teachers. Conventionally, in paper-based lesson plans or course design, it is not easy to evaluate the suitability of the multi-media resources that are involved. Instead, the online review system provides a more precise manner of reviewing function, especially when the pre-service teachers conduct instruction design for teaching with ICT media. This function is also believed to strengthen the role of tutor played by teacher educators and contribute to cognitive apprenticeship in the community with teacher education more tightly since they meet in the classroom only once a week.

Table 2. Cognitive meaning, prompts, and self-evaluation of lesson plan design based on the TEL model

<table>
<thead>
<tr>
<th>Stage</th>
<th>Cognitive meaning</th>
<th>Leading prompts</th>
<th>Self-evaluation (example)</th>
</tr>
</thead>
</table>
| Contextualization | Learners will confront an authentic and meaningful situation | What are the entry behaviors of students? Examples include their learned conceptions, experiences, and alternative conceptions. | • Can I list students’ experiences, pre-conceptions, and alternative conceptions related to my teaching topic?  
• Can I provide meaningful questions to incubate students’ ideas? |
| Sense making | Learners will visualize and represent the dynamic mechanics of the complex situation and simplify it | How to represent the scientific concepts in a teaching topic with proper mechanisms or principles | • Can I list the scientific concepts in my teaching topic?  
• Can I provide my students with opportunities to engage in discussion?  
• Can I explain the main variables in the scientific concepts? |
| Exploration | Learners will plan and carry out their experiments or, given access to information on databases, explore scientific principles or relationships among variables | How to guide students to explore the hypothesis and related variables | • Can I list the model of the scientific concepts in my teaching topic?  
• Can I promote students’ manipulation of different factors or variables related to the scientific concepts?  
• Can I guide students to form a hypothesis? |
| Modeling | Learners will form hypotheses or build models to explain their findings | How to help students establish a conceptual model | • Can I depict the model of the scientific concepts in my teaching topic?  
• Can I guide students to organize the relationships among variables and factors?  
• Can I guide students to confirm the correctness |
Application

Learners will get the opportunity to apply concepts to different situations and identify the limitations of their models.

How to design a new problem or to provide a new context for students’ utilization of their model?

- Can I provide a new context for students’ inspection of their own models?
- Can I guide students to select proper data or information to inspect the correctness of their model?
- Can I provide opportunities for student discussion of their model utilization?

Forming special interest groups online

Past research has indicated that the mutual interests of users on the Web will contribute to interactions among the members who participate in the online community (Hung, Tan, & Chen, 2005; Marra, Moore, & Klimeczak, 2004; King, 2001). This idea also echoes the idea that goal-oriented forum discussion can enhance interaction in a Web-based learning environment (Guzdial & Turns, 2000; Barab, Makinster, Moore, Cunningham, & the ILF Design Team, 2001; Schrire, 2006; Linn, Clark, & Slotta, 2003). In addition to supporting collaborative learning, the online forum breaks through the limits of time and field and offers equal opportunity for all users in asserting their opinions. It is thus essential to enhance the in-depth interactions of the community comprising those who participated in the teacher education program. According to the suggestion of Guzdial and Turns (2000), effective discussions can sustain and focus on topics related to class learning goals. As a result, the forum must be able to invite discussion and is tied to the curriculum. This is believed to prevent perfunctory chat and hence form a “normal discussion,” as proposed by Barab et al. (2001). With a mutual leaning goal, a special interest group can thus bear and consolidate the function of a learning community that was originally restricted in the classroom. This is why TEACH embodies a course-oriented discussion forum and invites all participants of the teacher education program, including teacher educators, pre-service teachers, and experienced teachers, as members of the learning community. In order to enhance the effective discussion of these members, the researchers also proposed several discussion topics and asked teacher educators to post on the forum. The sample topics included the following: “In microteaching, what difficulties do I meet when I prepare my teaching? How will I solve these problems? What assistance do I need?” “What problems will I meet when I teach with ICT, especially when there is enough or not enough equipment in my school? How do I overcome these problems?” “How do I grasp the attention of my students in a short time when I participate in microteaching, including their class climate and learning situations?” The discussion of these issues (comprising the issues initiated by pre-service teachers) both help pre-service teachers understand their peers’ ideas about instruction and promote teacher educators’ understanding of their students’ needs. Such a forum is intended to complement the insufficient function of the community in the classroom and created a better interactive environment.

DATA COLLECTION AND ANALYSIS

In order to reveal how pre-service teachers conduct teaching practice online and depict their experience with TEACH, an online self-report survey was used to collect the participants’ perceived usefulness of the innovation of the teacher education program. There were 18 items related to the three principles of innovation with a Likert scale. The scores, sorted from five to one, presented the opinions ‘strongly agree’, ‘agree’, ‘neutral’, ‘disagree’, and ‘strongly disagree’. The reliability of the survey was 0.80 and reached a satisfactory level. In addition, three open-ended questions in the survey were also included in order to understand these participants’ suggestions or comments regarding TEACH. The survey was administrated near the end of the Science Teaching Practice course. This will ensure that all of the pre-service teachers had experienced the functions of TEACH and created their own artifacts. Further, the artifacts that the participants created were also calculated or analyzed.

RESULTS

The results of this study are presented in accordance with the order of the three mentioned principles individually. The results first show the perceived usefulness related to enhancing peripheral participation in TEACH. Then the data related to strengthening cognitive apprenticeship in TEACH follows. Finally, pre-service teachers’ ideas regarding forming special interest groups online were presented.
Enhancing Peripheral Participation

According to the data shown in Table 3, the mean scores of the survey are higher than neutral except in the case of negatively stated items. The results indicate that the function of ‘enhancing peripheral participation’ in the teacher education course was perceived as quite useful. This also implies that a specifically designed Web-based environment can, possibly, contribute to teacher education to improve pre-service teachers’ peripheral participation in professional practice.

Table 3. Perceived usefulness of ‘enhancing peripheral participation’

<table>
<thead>
<tr>
<th>Description</th>
<th>Mean</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>The operation of designing lesson plans is clear in TEACH.</td>
<td>3.7</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>I can correctly complete the lesson plan design in TEACH.</td>
<td>4.0</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>The function of TEACH can satisfy my needs when designing a lesson plan.</td>
<td>3.7</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>The procedure of designing lesson plans in TEACH is too complicated.</td>
<td>2.4*</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>I will think about how to integrate the WWW into my teaching design when I</td>
<td>4.1</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>conduct design work in TEACH.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Designing teaching in a Web-based environment can help me to manage my</td>
<td>4.1</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>teaching resources, especially multimedia files.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creating a lesson plan design in TEACH stresses me.</td>
<td>1.8*</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>I don’t have to know much programming language to create a multi-functional</td>
<td>4.4</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>online course in TEACH.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can get teaching resources from my peers in TEACH.</td>
<td>3.9</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Sharing teaching resources is important to a community of teachers, especially to those who are pre-service.</td>
<td>4.2</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

*Negatively stated item

In the ten items of this dimension, item 5 and item 6 received the “strongly agree” opinion. The results show that the utilization of TEACH indeed improved the pre-service teachers’ reflection on the practice of instructional design using Web-based technology. These trainees also tended to believe that a Web-based authoring system was useful in conducting teaching preparation with multimedia.

In the online courses created by the pre-service teachers, the most frequently utilized module was tutoring (178 times, 65.0%). However, the usage of other modules, including online notebooks, forums, assignments, tests, and concept maps, was comparatively lower. The concept maps module was utilized only one time. This evidence indicates that these pre-service teachers had limited competence or inclination to conduct teaching other than lecture tutoring. This also implies that the teacher educators need to consider how to manifest the advantage that online course can engender.

Further, the data for item 9 and item 10 indicate that sharing resources was rather useful to the pre-service teachers. Their artifacts further support their responses to the survey. These trainees created and shared 62 lesson plans (2.13/per person). In these lesson plans, the most popular ones were frequently collected and utilized by their peers six times. Further, the pre-service teachers shared 861 teaching resources, including figures (185, 21.5%), documents (273, 31.7%), PowerPoint files (203, 23.6%), and movie clips (15, 1.7%) during the course. This evidence highlights the pre-service teachers’ focus on creating and sharing resources about teaching. It also implies that shared repertoire within a community has a degree of positive contribution to peripheral participation.
Strengthening Cognitive Apprenticeship

According to the survey data presented in Table 4, the pre-service teachers showed positive opinions toward the cognitive apprenticeship strengthened by TEACH in their teacher education program. The result for the first item shows the highest mean score (4.2) in this dimension. This indicates that the pre-service teachers perceived the importance of reflecting on the usage of ICT such that it would influence their teaching design. The results also imply that a Web-based environment that is well-integrated with a mentor’s role can decrease teachers’ workload when s/he perceives cognitive apprenticeship. In addition to conducting microteaching in a real classroom, these pre-service teachers also deemed online course design and virtual implementation to be a new experience that further improved their teaching competence.

Table 4. Perceived usefulness of “strengthening cognitive apprenticeship”

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online courses offer me more opportunities to reflect on the usage of information technologies in instruction.</td>
<td>4.2</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Comments and suggestions on instructional design from teacher educators in TEACH helped me greatly in teaching online.</td>
<td>4.1</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>I am confident in asking students to participate in my online teaching in TEACH.</td>
<td>3.4</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>I can effectively utilize the knowledge from teaching models provided by TEACH in implementing an online course.</td>
<td>3.4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Online course implementation has no significant difference from in-classroom microteaching.</td>
<td>2.4*</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

*Negatively stated item

Additionally, several of the comments and suggestions indicate that TEACH should offer more types of teaching models (methods) as references in guiding their instructional design. The results indicate that inexperienced pre-service teachers need more assistance in transferring their pedagogical knowledge into practice. This also implies that a Web-based environment has the potential to support the nurturing of pre-service teachers’ design competence in teaching when there is enough guiding information needed by inexperienced teachers. This is a key point with respect to cognitive apprenticeship in teacher education that shall be strengthened.

Forming Special Interest Groups Online

The data shown in Table 5 indicate that the pre-service teacher perceived the function of “forming special interest groups online” to be useful at a level slightly over neutral. In the results of this dimension, a noticeable diversity appeared in the pre-service teachers’ opinions (ranging from 5 to 1). The frequency of their responses in the forum within TEACH also indicate similar circumstances. Most of the discussions were gathered in the topics posted by the teacher educators (nine topics, 27 posts, 393 reading times). The topics posted by pre-service teachers were comparatively few (two topics, two posts, 97 reading times), even less than their reports of system problems. This indicates that some of the trainees believed that the forum in TEACH offered little help in improving their social interactions. In a Web-based forum that is related to their course, they would accept seminar discussion rather than actively initiate issues to elicit peers’ opinions. It is also possible that the pre-service teachers got used to other formats of communication over ICT. It is notable, when confronting the issue, to form a special interest group online.
Table 5. Perceived usefulness of “forming special interest groups online”

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>I will use the forum in TEACH to interact with other users.</td>
<td>3.2</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>I would like to share the teaching experiences with my peers in TEACH.</td>
<td>3.4</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>I don’t think the forum is an effective means of communication in a course.</td>
<td>2.8*</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

*Negatively stated item

However, since the forum in TEACH did not engender great enthusiasm in pre-service teachers, but the use of the forum in online course design presented the second highest percentage (39 times, 14.2%). This evidence reveals that the pre-service teachers were under the impression that discussion forum was beneficial to their teaching, at least in a Web-based environment. This merits further investigation to reveal why pre-service teachers performed differently when they participated in the special interest group online with different identities.

**DISCUSSION AND IMPLICATIONS**

This study started this research arguing the advantages of involving the rationale of situated cognition in teacher education. Then the insufficiency of current teacher education and the derived challenges to be overcome were described as the research purpose. The authors then proposed three applicable principles to overcome the challenges. Intending to innovate in conventional teacher education, a Web-based platform called TEACH was established with the rationale of situated cognition to provide additional guidance in the teacher education program. The authors then inspected the research participants’ perceive usefulness of TEACH to justify the argument of the situated cognition rationale in teacher education. The results of this study substantiate the principles to establish a Web-based environment to support a course of teacher education. Further, the Web-based environment indeed has the potential to make teacher education fit more with the rationale of situated cognition. Based on the results, this study explores three advanced implications in current discussion to address the research goal of our investigation.

Firstly, teacher education shall provide more opportunities to afford pre-service teachers’ practice with respect to competence in instructional design. Our findings regarding pre-service teachers’ perceived usefulness indicate that a Web-based environment needs to offer a goal-oriented context to support peripheral participation. This also echoes the idea that the professional development of teaching practice should be the aim in establishing a Web-based platform integrated into a teacher education program (Wedman & Diggs, 2001). In addition, the functionalities and interfaces of a Web-based environment enhanced pre-service teachers’ competence through reducing the teaching load of teacher educators and offering opportunities for pre-service teachers’ reflection on what they have observed, imitated, and practiced in the process of guided instructional design. Furthermore, pre-service teachers will be encouraged to design their lesson plans and course materials in a Web-based environment that can shape an extra social culture outside of the classroom to support their reflection and sharing in their teaching enterprise.

Secondly, an online implementation of Web-based teaching shall be emphasized as a supplement in teacher education. A Web-based course implementation through the Internet offers pre-service teachers more opportunities to experience authentic practice and peers’ interactions with respect to instruction on the Web. One might argue that this “authentic” experience is actually undertaken in a “virtual” environment and not acquired in a real classroom with real students. However, the authors neither treat online course implementation as a full replacement nor neglect the benefits that conventional microteaching can offer. The results of the current research simply offer positive support to the idea that a Web-based teaching guidance environment offers unique advantages, such as helping pre-service teachers to manage a Web-based course and related multi-media resources. As shown in the results of previous research, pre-service teachers can, indeed, gain experience with multiple ICT applications through designing online courses (Koehler, Mishra, & Yahya, 2007; Williams, Coles, Wilson, Richardson, & Tuson, 2000). In such circumstances, this “virtual” teaching environment is the best supplement for conventional teacher education. As a result, this study suggests that the future teacher education program shall employ a combination of conventional and Web-based forms of teaching practice. This implementation can also serve as a necessity to improve pre-service teachers’ core practice and further to
innovate in teacher education programs.

Finally, in-depth interaction shall be concentrated on and revealed in a new manner to determine the value of integration in teacher education. It is reasonable that the community of goal-oriented members will form its own cultural context. In such a cultural context, knowledge is constructed by the interactions among the members within it (Vosniadou, Ioannides, Dimitrakopoulou, & Papademetriou, 2001). Distributed intelligence is a good model for depicting the knowledge-sharing that takes place within a community of practice (Buysse, Sparkman, & Wesley, 2003). In most cases, the members of the community have different biographical backgrounds and offer different extents of participation. As expected, the members will also have different levels of the competence that is required to conduct their mutual practice. That is to say, the members of the community will be regarded as profitable subjects and will all have the opportunity to contribute their own expertise. Sharing of knowledge and collaboration will then emerge in the community of practice. Consequently, the community of practice can be considered a carrier that leads learners into a culture that encourages situated cognition. In teacher education, pre-service teachers, teacher educators, and mentors will be the main members that form a community of practice, i.e., a community of instructional issues. As for pre-service teachers, they enter the community to learn to teach and expect to become licensed teachers. Moreover, teacher educators and mentors play the roles of experts that guide the pre-service teachers to conduct their mutual practice of teaching and improve their competence. While the pre-service teachers may appreciate more the social context that the community provides, this will provide them with the opportunity to become better acquainted with the core values of the teaching practice. A Web-based learning environment such as the TEACH supports community of practice, and thus offers a juncture at which teacher educators can rethink the effects of social interactivities other than discussion forums or seminars in the classroom in a conventional program of teacher education. In addition to gaining teaching experience, pre-service teachers can also gain from the community experience and encouragement in developing their communication skills for interacting with experts and peers in their field. As a result, they will be able to create and share teaching resources with each other and to refine their cognition with regard to teaching practice. It seems that pre-service teachers are likely to dedicate a lot of effort to the community. In fact, they are in the process of acquiring a valuable intangible possession that will support their future teaching careers.

CONCLUSION
This paper discusses the rationale of situated cognition in teacher education. Some drawbacks that can occur when the ideas are applied in conventional teacher education are also suggested. These assertions illuminate the possible directions that might be followed in innovating within current teacher education programs. For a Web-based environment that encompasses situated cognition in teacher education, enhancing peripheral participation, strengthening cognitive apprenticeships, and forming special interest groups online were proposed as a means of confronting the challenges that teacher educators encounter in the modern educational milieu. In the future, researchers can employ the principles and implications proposed in this paper to engage in constructing a teaching guidance platform through the Internet and to manifest the value of situated cognition in teacher education. In addition, this study suggests that a larger population of pre-service teachers outside the field of science shall be invited in future research. Also, further tracking of pre-service teachers is suggested when they become teacher interns and in-service teachers. These approaches will accentuate a deeper understanding of pre-service teachers' perceptions of a Web-based environment within a teacher education program and provide a profitable direction for revision in preparing teacher prospects.

REFERENCES


EXPLORING THE IMPACTS OF ANALOGIES ON COMPUTER HARDWARE

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ABSTRACT
In the last few decades, analogy, which is considered as a special case for reasoning, has attracted a great deal of
attention from cognitive scientists. Although analogy was rarely applied in previous decades, now it is often
considered by educators and researchers as a strategy to provide creative solutions and poetic writing (Paris &
Glynn, 2004). Today, teaching models through analogy are used in different fields successfully and found to be
beneficial for unobservable phenomena (Trey & Khan, 2008). Moving from the findings of previous studies, this
study aims to explore the effects of detailed analogies on students’ learning success in studying the working
rationale and hardware components of the computer. 86 students in 1st and 2nd grades of Computer and
instructional Technology Department volunteered to participate in the study. The sample was divided into two
groups randomly: the control group who received the lectures without using analogies and the experimental
group who were taught using detailed analogies. The data was collected through pre- and post-tests at the
beginning and at the end of one academic term. The results of the analyses show that the students’ success was
significantly higher for the group taught via detailed analogies. Considering the low number of studies conducted
to identify the effects of analogies on computer sciences learning, the findings of this present study are supposed
to contribute to other studies in the field.

Keywords: teaching/learning strategies, computer learning strategies, analogy

INTRODUCTION
Examining pedagogical strategies which encourage students’ conceptual understanding of the way the world
works is very important. (Efendioğlu & Yelken, 2010; Trey & Khan, 2008) One of the strategies used to support
this type of understanding is analogy. An analogy is “a comparison of identity or similarity of elements or
relations, that is, on shared properties or identical relations” (Johansen, 2002, p.191). Gentner & Gentner (1983)
highlight the importance of analogies in enhancing students’ cognitive development by helping them to build on
their previous knowledge.

Analogy is one of the most important tools used to accelerate conceptual change in scientific learning, and to
develop teaching and learning scientific reasoning and inventions (Duit, 1991). In other words, it is an art of
exact illustration of real life situations that provides learner the shortest and most effective way to reach learning
objectives, and that facilitates his/her learning of concepts.

Throughout the history of science, analogies have been frequently used by scientists and science educators to
explain fundamental elements such as the components of the cell (Glynn & Takahashi, 1998; Paris & Glynn,
2004), vocabulary and structure items when learning a foreign language (Klein, Piacente-Cimini & Williams,
2007), the laws of chemistry (Trey & Khan, 2008), the laws of physics (Duit, Roth, Komorek, Wilbers, 2001).
Since analogies provide initial models for concepts they are also used by textbook authors to explain science
concepts to students (Iding, 1997). Expressions like “similarly,” “likewise,” “just as,” and “that is comparable
to” are used by many authors to preface their analogies as indicators of analogies they are about to use. (Glynn &
Takahashi, 1998)

Analogy necessitates mapping of the elements and relationships of one domain into another by finding
similarities and differences between them via reasoning which is a complex cognitive process Mapping is
conducted among familiar structures (a set of physical and functional properties) of the analogy with new
structures of the target. Researchers argue that this “mapping” process consists a comparison of knowledge
already acquired in long-term memory with an individual’s ongoing interaction with their environment and their
empirical observations that engage sensory memory. Working memory serves as the arena for linking familiar
and new structures where continuing repetitions and confirmations of the empirical observations foster cognitive
processes. As a result of analogical reasoning, there can be an emergence of an enriched internal cognitive
representation or mental model which may be subsequently stored in long-term memory. Mainly three
hypotheses are suggested by this theory of analogical reasoning: “(1) analogies can provide a familiar basis for
building a new concept, (2) analogical reasoning is supported by a dynamic correlation between new and

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familiar structural relations, and (3) an enriched mental model can be generated as a result of analogical reasoning” (Trey & Khan, 2008, p.520).

However, the results of the studies indicate that the use of analogies for instructional purposes is limited when students’ analogical, or correlation reasoning, or visual imagery is constrained (O’Brien, 2002). Another difficulty may also emerge in case students cannot map the familiar onto new empirical phenomena while being engaged in scientific activity (and accessing images of concepts from their memory).

In this respect, for some researchers computer-based analogy can assist students with an explicit visualization of the relationship between the familiar and the new phenomena within a single multimedia environment. When students can come up with an accurate mapping between the analogy and the target, their analogical reasoning can be supported by a dynamic and visualized correlation of two structural relations (Trey & Khan, 2008). Therefore, analogies have been used successfully in many areas from sciences to social sciences. According to Wolters (1998), for example, analogies in science text designed to promote elaboration, can enhance the cognitive process of constructing relations between what is already known and what is new. This, ultimately, supports comprehension and increases intrinsically motivation.

Hamilton (1997) points out to the importance of elaboration as a way of using detailed analogies. He defines elaboration as “any enhancement of information which clarifies or specifies the relationship between information to-be-learned and related information, i.e., a learner’s prior knowledge and experience or contiguously presented information” (Hamilton, 1997, p. 299). Elaboration can be activated by questions, objectives, personal examples, and other strategies (e.g., Martin & Pressley, 1991; Seifert, 1993; Willoughby, Wood, & Khan, 1994). Here, analogies are very effective since they can provide rich, redundant contexts for elaboration (Paris & Glynn, 2004).

Building relations between the existing and the new knowledge is crucial in interpreting students’ learning as a process of conceptual change (Demastes, Good, & Peebles, 1996; Duit & Treagust, 1997; Hewson & Hewson, 1992; Strike & Posner, 1992). Familiar analogies (e.g., water is like electricity in some ways) are supposed to serve as early mental models to provide develop cognitively and learn more science and ultimately will evolve beyond these simple situated analogies, adopting more sophisticated and powerful explanatory models (Glynn & Duit, 1995; Iding, 1997; Lehrer & Schauble, 1998).

In computer sciences, because the concepts are so abstract, it is obvious that these concepts are almost impossible to be perceived with sense organs. Some different tools are needed for them to be understood. Because there are so many different hardware components and there are a lot of sub-components of these components, experts sometimes interpret them differently from each other, which causes students to form “misconceptions” (Brown, 1992). Since misconceptions can hinder understanding they should be avoided by analogies. The use of analogy is one of the methods that can be used in computer technologies because teaching students these difficult scientific topics through visual and real-life materials will be very effective. It has been reported that if students are actively involved and can link up the analogy and behavior, their misconceptions decrease (Brown, 1992; Silverstein, 2000).

To be able to avoid such problems, students can create their own analogies to enhance the conceptual change (Wong, 1993). For creating their own analogies, students should be both capable and willing to do it (Gabel & Sherwood, 1980). Otherwise, wrong sampling may cause misunderstanding of the concepts, and considering that this inaccurate information may be corrected really hard, the experts should use analogies really careful (Atav, Erdem, Yılmaz, & Gücüm, 2004)

One of the fastest developing one is informatics technologies. With the rapid developments in technology, new products are being introduced every day. In addition to the increasing number and function, it is also hard for students to understand the topics about computer hardware because they cannot be easily associated to real objects. That’s why, using analogies for teaching these topics makes it easier for the students to understand and remember.

In this respect, this study aims to find out the effects of analogies used in different fields of computer sciences. Detailed analogies such as picture, simulation, etc. were used for teaching unobservable concepts in computer sciences. These detailed analogies were found to be useful in enhancing the students’ learning.
The study searches answers to following research questions: 1) Can detailed analogies support student understanding of computer hardware learning? 2) What are students’ views about learning with detailed analogy?

METHOD
Research Design
The study was conducted at Computer and Instructional Technology Department. The sample consisted of 86 volunteer (32 girls and 54 boys) students at the first and second grades. The students were divided into two groups, 43 in each group. The control group was taught the topics in traditional ways while the experimental group students via detailed analogies three hours a week during two months.

Students are supposed to know basic elements of computer hardware since they had a course called Information Technology in Education which teaches about hardware parts in 1st year. To measure their actual level of knowledge, a pre-test was applied to both groups. A post-test was then applied after a teaching period of two months. Students in experimental group were also requested to fill in a questionnaire.

While teaching computer hardware topics, electronic circuit parts were first given. While the control group was given the existing definitions and some figures, the experimental group was taught by using real-life samples. The samples’ reliability was tested by taking experts’ opinions. One of the samples is as shown in Figure 1.

Circuit Element. Capacitor

Control Group

A capacitor is an electrical or electronic component consisting of a pair of conductors separated by a dielectric (insulator). Also known as condenser, capacitor was invented in 18th century and has become one of the indispensable elements of electrical and electronic engineering which has great importance in the progression of technology. Capacitors are essential elements for all integrated electronic components and are widely used in storing electrical energy, controlling reactive power, switching between AC and DC.

Experimental Group

A capacitor is an electrical or electronic component consisting of a pair of conductors separated by a dielectric (insulator). To make this clearer, we will give an example from daily life. Imagine now a tap and a bucket under this tap and suppose that the water flowing from the tap is not fixed and also suppose that the water is cut off from time to time. If we turn on the tap completely while so little water is coming out, there would be a full flow of water and consequently the water would begin to overflow from the bucket. In case of any water cut off, we would also not have enough water while we will need it. Now imagine that we will build a tank to prevent this kind of problems and will let the water flow in this tank. Imagine also that we will put another tap at the bottom of this tank. Water flowing from the second tap would be fixed regardless water flow of the first tap. A capacitor, gives a fixed current to circuit components in the same way.

Figure 1. Teaching a Capacitor in Traditional Way and Via Analogies
After explaining electronic circuits to students, computer hardware units were introduced and the aim of producing these units was explained. These units were explained to experimental group as if they were human organs, as shown in Table 1.

<table>
<thead>
<tr>
<th>Computer Hardware</th>
<th>Human Body Part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keyboard + Mouse + Printer</td>
<td>Hand + Finger</td>
</tr>
<tr>
<td>Hardisk</td>
<td>Brain (Long Term Memory)</td>
</tr>
<tr>
<td>Ram</td>
<td>Brain (Short Term Memory)</td>
</tr>
<tr>
<td>CPU</td>
<td>Brain (Central Process)</td>
</tr>
<tr>
<td>Data Bus</td>
<td>Nervous System</td>
</tr>
<tr>
<td>Power Cable</td>
<td>Veins</td>
</tr>
<tr>
<td>Camera &amp; Scanner</td>
<td>Eyes</td>
</tr>
<tr>
<td>Speaker</td>
<td>Mouth &amp; Lip</td>
</tr>
<tr>
<td>Microphone</td>
<td>Ears</td>
</tr>
</tbody>
</table>

While teaching CPU, one of the computer hardware units, it was found that the students had the analogy that it is the brain of the computer. This information is both wrong and inadequate because human brain not only performs transactions but it also has much more functions such as memory, etc. This misconception made the students have the wrong idea that the information in the computer was stored in CPU.

A school workbench was chosen as an analogy to teach differences between RAM and other storage volumes. Analogy; “let’s imagine a model making. And now, let’s imagine that we put materials we need on our workbench while making the model. In this manner, we could work quickly because we reach easily all materials. But after a while, we would not have enough places on the workbench as we will begin to build parts of the model and our work would slow down. Therefore, let’s put the parts built in a larger and safer place, like a cupboard. We should also put the materials away before leaving the workroom to prevent damage to our materials. Otherwise the materials on workbench could be removed by cleaning persons because this workbench has been temporarily assigned to us. In this example, workbench is RAM and cupboard is hard drive. In other words, files we will need for a short period of time or smaller size files are stored in RAM. If we want to keep them permanently, we should store them in hard drives or in other permanent storage mediums. Some programs can run directly without installation while others need to be installed in hard drive. The reason for this is that we should store in larger places materials too big for the workbench which would limit our working place. Moreover, as we shut down all energy while leaving the room, the cleaning persons would remove all materials on the desktop. This example shows us that all information in RAM will be removed when the computer is shut down and that RAM is a temporary storage area”

While teaching logic gates, an analogy of bus and bridge was given. Analogy; “Logic gates are widely used in computers and electronics. In gates, we use codes 0 and 1. 1 means high input or output and 0 means low input or output. There are two basic gates; a) AND gate b) OR gate. Let’s consider gates as a swing bridge and codes as a bus coming to school. AND gate, as shown in Figure 2, is a bus and has to come to school by crossing the bridges A and B. Both bridges should function well, namely at value 1, so that the bus comes to school. If the bridges A and B are 1 then the bus will be able to come to school; that is to say, C value will be 1. Even one of the two bridges does not function, namely, C value is 0, the bus will not be able to come to school. In that case, there would be no output current in the circuit. At least one bridge should function in OR gate. Even if one of the bridges does not function, the bus will be able to come to school by using the other bridge, as shown in Figure 3.
The effects of detailed analogies technique of teaching computer hardware concepts on students’ academic success were examined. The pre-test consisting of information about computer hardware was applied. Moreover, the students were given an extra page with pre-test which sought for their personal information such as their high schools, sex, etc. The post-test was used for evaluating the scores of students once after the lecture has been given in traditional and detailed analogical methods. Additionally, in order to assess their opinion on analogy techniques, the post-test also featured a survey for students who were subjected to detailed analogical methods.

**Data Analysis**

The data was collected in March and April, 2009, and it was transferred to computer environment. The data then was analyzed using One Factor ANCOVA test on SPSS, and their frequencies and significances were calculated.

**RESULTS**

A total of 86 students -32 female and 54 male- have participated in the research. The students were divided into two groups consisting of 16 female and 27 male students each. The pre-test / final-test results acquired through statistical calculations have been shown in Table 2.
The pre-test results showed that the average of students in control group was 35.69 % and that in experimental group had 36.39 %, as shown in Table 2. No significant difference was found between groups for pretest, \( t(84) = 0.176 \) (sig. = 0.861), \( p > 0.05 \), as shown in Table 3. This suggests homogeneous distribution between groups. According to pre and post-test results, the control group students rose their academic success in proportion of 26.28 %. The experimental group students who were taught the topic via detailed analogy increased their academic success in proportion of 47.79 % as shown in Table 2. These results show a significantly positive effect of detailed analogies on learning computer hardware units.

Moreover, there was a significant difference between the elaborate analogy used for computer hardware learning and the posttest, \( F_{(1-83)} = 34.14 \) (sig. = 0.00), \( p < 0.05 \), as shown in Table 4. It was 61.97 % for the control group and 84.18 % for the experimental group.

In the interviews conducted with experimental group, they were asked to evaluate the detailed analogies used for teaching the topics. 90.68 % of the students (n=39) found it very good; 2.33% of them (n=1) found it good; 6.99% of the students (n=3) found this technique fair average. The students, who have achieved average scores, have reported that they have misinterpreted or failed to comprehend some analogies, which resulted in conceptual misunderstandings that led them to their results.

One of the students who found analogies very good stated that “in some forums on the Internet, CPU is stated as the brain of the computer. I always knew just like this. I always thought that all the operations in the computer were accomplished by the CPU, even the data was saved in the CPU. But now I know that CPU, RAM, HDD, etc. have different functions.” Another student said that I had not understood how 1 and 0 go from one card to another. But giving the example “the nerve cells” made it very clear for me. Besides, I now understand how computers still work when power cuts less than a second. Before condenser discharges, the main tap fills the bucket.”
The students in the control group were given several example analogies once after the post-test has been conducted and they were asked whether using analogies in lectures from that point on would be beneficial for them or not. 88.37% of the students (n=38) have reported that they definitely support the use of analogies in lectures while 9.30% (n=4) reported that it would not make any difference for them and 2.33% (n=1) reported that they do not want analogies. The students who were against analogies have been asked the reason of their statements and their answers were that they already knew the topics prior to the lecture and that was why they had scored high on the pre-test and the post-test.

DISCUSSION AND CONCLUSION

This study aims to find out whether detailed analogies support student understanding of computer hardware learning and tries to elicit students’ opinions about learning via detailed analogy. In parallel with many previous studies (Klein, Cimini & Williams, 2007; Wang & Wu, 2008; Paris & Glynn, 2004; Trey & Khan, 2008; Tartwijk, Rijswijk, Tuithof & Driessen, 2008), the results of this study indicate that detailed analogies enhance students’ learning of computer hardware topics.

The statistical analysis of the data shows that using detailed analogies in computer hardware is more beneficial than the traditional teaching methods. Moreover, it was found that analogies had a positive impact on students’ academic success, and it raises the level of information retention. By systematically mapping verbal and visual features of analogy concepts onto those of target concepts, analogies can facilitate elaboration, the cognitive process of building relations between what is already known and what is new (Paris & Glynn, 2004).

Another important result emerging from the study is that students were observed to create their own analogies after they were introduced analogies and the way they are used. At the end of the two-month period, there was also an increase in the number of inclusive education in-group activities.

However, during the process, students sometimes interpreted the analogies improperly. In line with this finding, some researchers and educators have expressed a concern over the use of analogies because of the potential for learners to form misconceptions or “alternative conceptions” (Donally & McDaniel, 1993; Zook, 1991; Zook & Maier, 1994). Thus, in some topics students were assisted to change their wrong analogies. In line with Paris & Glynn’s (2004) findings, the results of this study, in this respect, suggest that an elaborate analogy can help learners to make correct inferences by making the similarities between the analogy and the target concept verbally and visually explicit.

To be able to avoid these drawbacks, the instructor who plans to use analogies should conduct a pilot study with the analogies to be used and identify any possible misinterpreted analogies so that they can be clarified and/or modified accordingly. It is also advised to use different analogies for the same concept, and to support these analogies with pictures, videos, figures, etc. This suggestion was stated by a student as “an analogical simulation taken from a web page to explain how dual-core processors work rose my understanding substantially.” Elaborate analogies likely do these by establishing in learners a sense of self-relevancy or personal involvement (McWhaw & Abrami, 2001; Wolters, 1998). This explanation has also been supported by other students’ responses in the interviews. Most of them indicated that the elaborate-analogy text was most interesting because it compared an abstract science concept to something more familiar to them. A typical comment was: “I know about photography. So it was more interesting when the eye was compared to a camera.” This is a common characteristic of learners who are described by Wolters (1998) as being actively involved in the self-regulation of their learning. These learners frequently state “I think about how the material relates to my life” and “I connect the material to information that I already know” (Wolters, 1998, p.233). According to Wolters (1998), learners who are self-regulating their learning are more likely to be engaging in elaboration, critical thinking, and metacognition (Paris & Glynn, 2004).

The overall result of the study clearly maintains that detailed analogies are successful in teaching computer hardware. Therefore, it is suggested that detailed analogies be used frequently, especially while teaching hardware units, and they should be supported with pictures, videos, figures, etc.. For further studies, it is recommended to extend analogy for the learners, and to research the effects of analogies upon retainment in learning.

REFERENCES


FACTORS AFFECTING THE COMPUTER USAGE OF PHYSICS TEACHERS WORKING AT PRIVATE TRAINING CENTERS

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ABSTRACT
The rapid development of computer and instructional technologies eases our lives in many ways. Private teaching institutions have become one of the most important entities in the educational system of Turkey. The topics spelling at private teaching institutions will determine the university as well as the departments that the students are going to be enrolled as well as the quality of the education and instruction they will receive at those institutions. Physics classes, due to the extensive amount of abstract concepts, are at the top of the classes causing students difficulties. Therefore, computer supported instruction will facilitate the comprehension of the students which would otherwise be difficult to understand. The present study is conducted with 40 physics teachers, 24 males and 16 females, working at the 20 branches of a private course in Ankara throughout the spring semester of the 2009-2010 academic year. The statistical analyses conducted showed that the majority of physics teachers believed that the use of computers facilitates learning.

Keywords: physics education, computer based instruction, private teaching institutions.

INTRODUCTION
The rapid population growth in Turkey made better education for individuals compulsory for better life standards. Every year millions of students compete with each other in order to score better at mainstream exams such as SBS and ÖSS. In an exam system where the success of one student depends on the failure of another, parents as well as students prefer private teaching institutions in order to prepare best possible for these exams.

These educational institutions founded by locals and foreigners, real personalities and corporate bodies, under the supervision and control of the Ministry of Education, giving education for a certain price are labeled private teaching institutions (Çolak, 2006). Private teaching institutions are foundations established to compensate for the lacking knowledge at main stream exams such as SBS and ÖSS, and to support the students who want to prepare themselves better for these exams. The education, either of supporting or reinforcing nature provided at these private teaching institutions, preferred by the students who want to be successful, is conducted parallel to the education given at state schools (Temel, 2007).

The conditions of the 21st century, making life long learning obligatory, show clearly that Single quotes education and instructional activities will not suffice. The obligation to present information in various ways throughout the educational process enforces the use of new instructional technologies instead of traditional educational tools and devices (Kaput, 1991).

Educational technologies is a frequently but many times ambiguously used concept in education and as well as in other areas. Whereas this concept means for some any material used to support education, for others it is a novel and special approach for the realization of one particular aim of education and instruction (Ely, 1993). The concept of educational technology can also be defined as the systematic and planned activities for the best possible creation of a teaching and learning environments (Jennings et all., 1985). In its broadest sense educational technologies, as a theory and practice, expresses the design of instructional materials, adaptation and evaluation of these interactively with the teaching methods (Seels & Richey, 1994).

Among the Information and Communications Technologies (ICT) the most popular and most important one is the computer, enabling the information provided in the lessons to be retained permanently and to keep students interest for the lesson constantly alive. Collins (1991) mentions the change that computers have brought about and states that the use of computers necessitates active learning enabling the students and society to direct towards a more constructive perspective.

Computer supported education is the use of the computer as an environment for learning increasing the motivation and learning process of the students. The findings of previous research suggest that computer supported education increases the success of the students more compared to traditional methods of education (Chang, 2002). Moreover, besides increasing the success of the students, it also increases the higher order thinking skills and hence enables the comprehension of the student rather than memorization (Renshaw &
Taylor, 2000). Nowadays, it’s indispensable during education period to use audio-visual materials for the presentation of an effective education (Koşar, Çiğdem, 2003). The necessity to use computer in education is resulted from reasons such as difficulty in education system, rapid increase in the number of students, increase in amount of information and its more complicated content and insufficient teachers and individual ability differences which become crucial. Some governments endeavor allowing computer-aided education full play in their education policy. In Japan, it’s a known fact that the level of success increased in the classes which were equipped with “Multimedia” facilities. In Israel, on the other hand, 42% success rate in mathematics lecture increased up to 99% by preparation of middleware software and as a result of its application by computer-aided education (Cameron, 1992). In USA, schools have been making a purchase of technology for years in the hope of teachers and students using it in order to increase their efficiency. Providing software and equipments to schools in an increasing rate makes it possible for a rapid access of them (Zehr, 1998).

As stated by Fullan (1991) the prime role is on the teachers to apply improvements and realize changes. The decisions, experiences, approaches, beliefs, and manners of teachers directly affect computer usage in education (Andris, 1995; MacArthur & Maloof, 1991; Marcinkiewicz, 1993; Moursund, 1979; Stevens, 1980; Yaghi 1996). Some teachers who have positive manners towards computers use them in their classrooms (Casey, 1995; Schrum, 1993).

Teachers, who are going to prepare themselves and their students for the information age, are to get accustomed to ICT supported school culture as soon as possible (Leh, 1998). Teachers can acquire new information rapidly and transfer them to their students by means of educational technologies (İşman, 2002). According to many researches, computers are not used precisely by most of the teachers even if they are easily accessed (Hunt, Bohlin, 1993; Marcinkiewicz, 1993; OTA, 1995). Lack of information and inadequate education are the most important two problems for usage of computers in education (Andris, 1996). Many teachers in USA are not educated adequately for the aim of using computers in the classrooms (Hardy, 1998; Henry, 1993; Jordan & Follman, 1992; Lyons & Carlson, 1995; Okinaka, 1992; OTA, 1995). Teachers need more time and support of school management in order to integrate technology into education and prepare new teaching plans, advanced applications and new lectures (Becker, 1994; Honey & Henriquez, 1993; Honey & Moeller, 1990; Loucks & Hall, 1987; Hunt & Bohlin, 1993; OTA, 1995; Sheinguld & Hadley, 1990; Wiske, 1987).

The effectiveness of the computers throughout the teaching process has contributed to its use in teaching physics. The use of computer supported physics classes will cease to make physics to be considered as the most difficult lesson to be understood by students who are preparing for the university majoring in mathematics. The computer supported material for teaching electrostatics in Physics has resulted in facilitating students’ success (Saka & Yılmaz, 2005). The current condition of computer supported education in private teaching institutions, to which we send our children paying large amount of money, is besides the possibilities and the views of physics teachers a topic to be researched. There are many studies about the use instructional technologies at the primary and tertiary level. However, no studies were conducted regarding the use of technology in private teaching institutions. The present study is significant in that regard. In the present study factors effecting computer supported physics applications, the possibilities and views of teachers to conduct computer supported physics education, and the demographic features of physics teachers are analyzed.

The present study was conducted to determine the views of physics teachers teaching at private teaching institutions, the possibilities to conduct computer supported physics classes, and the factors effecting computer supported physics classes.

**METHOD**

A triangulation method has been employed in the present study. In the social sciences, triangulation is often used to indicate that more than two methods are used in a study with a view to double (or triple) checking results. This is also called "cross examination" (Cheng, 2005).

The idea is that one can be more confident with a result if different methods lead to the same result. If an investigator uses only one method, the temptation is strong to believe in the findings. If an investigator uses two methods, the results may well clash. By using three methods to get at the answer to one question, the hope is that two of the three will produce similar answers, or if three clashing answers are produced, the investigator knows that the question needs to be reframed, methods reconsidered, or both.

Triangulation is a powerful technique that facilitates validation of data through cross verification from more than two sources. In particular, it refers to the application and combination of several research methodologies in the study of the same phenomenon (Bogdan & Biklen, 2006). By combining multiple observers, theories, methods,
and empirical materials, researchers can hope to overcome the weakness or intrinsic biases and the problems that come from single method, single-observer and single-theory studies. The purpose of triangulation in qualitative research is to increase the credibility and validity of the results.

**Scope and Sample**
The scope of the present study consists of the physics teachers working at private teaching institutions in Ankara; whereas the sample of the study consists of the 40 physics teachers, 16 males and 24 females, working at 20 affiliations of a private teaching institution in Ankara. Detailed information is given in the table 1 below.

<table>
<thead>
<tr>
<th>Table 1: Data regarding the sample</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td><strong>Faculty of Graduation</strong></td>
</tr>
<tr>
<td>Faculty of Education</td>
</tr>
<tr>
<td>Faculty of Humanity and Letters</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td><strong>Seniority</strong></td>
</tr>
<tr>
<td>0-5 years</td>
</tr>
<tr>
<td>6-10 years</td>
</tr>
<tr>
<td>11-15 years</td>
</tr>
<tr>
<td>16-20 years</td>
</tr>
</tbody>
</table>

According to Table 1, the majority of the teachers (72.5%) have seniority over five years.

**DATA COLLECTION AND ANALYSIS**
In the present study a 20 item questionnaire developed by Alev (1997) has been employed. The questionnaire consists of 20 questions out of which three were directed to determine the profiles of the participating physics teachers and seventeen at computer supported physics education. The Cronbach Alpha coefficiency has been found as .92. Furthermore, with a randomly selected group of teachers a semi-structured interview and observations were conducted according to previously prepared observation forms. The views of specialists were taken into consideration during the preparation of the semi-structured interview and observation form. The data were analyzed using SPSS11.00 statistics program. In the analysis of the relevant data frequency dispersion, percentage, and \( \chi^2 \) (Chi-square) tests are used. In the evaluation of the statistical results \( p = .05 \) level is taken as the significance level.

**Findings**
This section provides the answers that the teachers have given to each question in the survey in frequency and percentage besides the \( \chi^2 \) (Chi-square) analysis results of the teachers’ views regarding the factors affecting the use of computers during teaching physics classes.

<table>
<thead>
<tr>
<th>Table 2: Data regarding the answers that the teachers in the sample provided to the questions.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Questions</strong></td>
</tr>
<tr>
<td>What is the average amount of students in your classes?</td>
</tr>
<tr>
<td>Less than 10</td>
</tr>
<tr>
<td>10-20</td>
</tr>
<tr>
<td>21-30</td>
</tr>
<tr>
<td>More than 30</td>
</tr>
<tr>
<td>How many computers for instructional purposes are there in the private course you are working?</td>
</tr>
<tr>
<td>1-3</td>
</tr>
<tr>
<td>4-6</td>
</tr>
<tr>
<td>7-9</td>
</tr>
<tr>
<td>10+</td>
</tr>
<tr>
<td>How many students per computer are assigned?</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>4+</td>
</tr>
<tr>
<td>Do you have a special interest in computers?</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>A little</td>
</tr>
<tr>
<td>Question</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Do you share the view that computers are technological devices facilitating learning?</td>
</tr>
<tr>
<td>Totally Agree</td>
</tr>
<tr>
<td>Agree</td>
</tr>
<tr>
<td>Partially Agree</td>
</tr>
<tr>
<td>Do not Agree</td>
</tr>
<tr>
<td>Never Agree</td>
</tr>
<tr>
<td>Can you conduct computer supported physics classes?</td>
</tr>
<tr>
<td>Yes I do</td>
</tr>
<tr>
<td>Sometimes I do</td>
</tr>
<tr>
<td>I do not</td>
</tr>
<tr>
<td>Did you receive any computer related classes during your B.A years?</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>What were the computer related classes during your B.A years?</td>
</tr>
<tr>
<td>Computer Education</td>
</tr>
<tr>
<td>Computer Supported Education</td>
</tr>
<tr>
<td>Computer Supported Physics Education</td>
</tr>
<tr>
<td>Introduction to Computer</td>
</tr>
<tr>
<td>Were these classes sufficient?</td>
</tr>
<tr>
<td>Partially</td>
</tr>
<tr>
<td>Insufficient</td>
</tr>
<tr>
<td>How many classes per week were these classes?</td>
</tr>
<tr>
<td>Three hours</td>
</tr>
<tr>
<td>Four hours</td>
</tr>
<tr>
<td>Have you ever participated in course on computer usage or computer supported education?</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>If you have joined any in-service courses, what were the content of these?</td>
</tr>
<tr>
<td>Computer Supported Education</td>
</tr>
<tr>
<td>Both</td>
</tr>
<tr>
<td>How long were the courses that you have participated?</td>
</tr>
<tr>
<td>3 months</td>
</tr>
<tr>
<td>4-6 months</td>
</tr>
<tr>
<td>Were these courses able to provide you enough information to conduct computer supported physics classes?</td>
</tr>
<tr>
<td>Partially</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>What are the difficulties that you have while using the computer during physics education?</td>
</tr>
<tr>
<td>Insufficiency of the programs for computer supported physics classes</td>
</tr>
<tr>
<td>High number of students</td>
</tr>
<tr>
<td>The lack of a computer in the private course for educational purposes</td>
</tr>
<tr>
<td>Are there any institutions that you can turn to if you have any difficulties in computer supported physics classes?</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>What are the superiorities of computer supported physics classes compared to other methods for high school students?</td>
</tr>
<tr>
<td>It’s fast</td>
</tr>
<tr>
<td>It’s permanent</td>
</tr>
<tr>
<td>It increases students interest</td>
</tr>
</tbody>
</table>

On analyzing the data in Table 2, it wording amount of the students is 10-20 (62.5%). It is interesting that there are not any classes with less than 10 students. There is not a computer per person ratio in the private teaching institutions participating in the present study. The interest of the teachers in computers is only 27.5% in the sample is thought provoking. Moreover, whereas 55.0% shares the view that the use of computers has a positive impact on learning, a 40.0% partial agreement is also meaningful. Whereas 27.5% of the teachers state that they can not conduct physics classes computer supported, only 17.5% of the sample conducts physics classes always computer supported. It can also be seen that these teachers received computer related education during their B.A. years (Table 2).

According to the findings of the present study; the majority of the teachers have had computer courses (55.0%) and introduction to computer classes (32.5%) during their collage years. The majority of the participants state that they had two hours a week computer courses (52.5%). Most of the teachers stated that the computer courses
The results obtained from the χ² analyzes could not find a significant relationship between the gender of the physics teacher and computer supported physics class (χ² value = 1.479, degree of freedom (df) = 2, p = .479). A meaningful relationship was found between the special interest of the participant in computers and conducting the physics classes computer supported (χ² value = 25.939, df = 4, p = .000). There was also a meaningful relation between the views of the teachers who regarded computers as technological means and teachers’ conducting their physics classes computer supported (χ² value = 23.497, df = 6, p = .001). No meaningful relation was found between student per computer and teachers’ conducting their physics classes computer supported (χ² value = 7.649, df = 8, p = .468). No significant relation was found between teachers’ seniority and teachers’ conducting their physics classes computer supported (χ² value = 5.700, df = 6, p = .458). A significant relation was found between teachers participation in-service computer education courses and conducting their physics classes computer supported (χ² value = 9.486, df = 2, p = .009). No significant relation was found between teachers opportunity to turn to an institution or person if they faced problems in conducting computer supported classes and teachers’ conducting their physics classes computer supported (χ² value = .657, df = 2, p = .720).

OBSERVATIONAL FINDINGS

In order to determine the conditions of the physics teacher teaching at private institutes observations were made in their natural settings. Criteria regarding students’ behaviors, interest in the lesson, participation, and the overall teaching of physics have been considered and notes related to each were taken. Observations lasting for four hours were conducted with eight teachers out of which; four mentioned that they used computers in every of their physics classes, two from time to time, and two they did not use any computers at all. The findings from the observations are presented in Table 3.

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Use of computer</th>
<th>Topic</th>
<th>Student Interest</th>
<th>Time use</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Taught using simulation</td>
<td>Electric circuits and brightness of lamps</td>
<td>Students listened attentively</td>
<td>Was able to cover the topic and do sufficient exercises</td>
</tr>
<tr>
<td>B</td>
<td>Used a package program readily available</td>
<td>Electromagnetic induction</td>
<td>Students attention was good</td>
<td>Was able to cover the topic and solve sample questions</td>
</tr>
<tr>
<td>C</td>
<td>Taught using his own presentation on his computer</td>
<td>Energy topic</td>
<td>Students interests in the lesson was very high</td>
<td>Was able to teach the topic and solved together a lot of sample questions</td>
</tr>
<tr>
<td>D</td>
<td>Used a package program readily available</td>
<td>Force movement and Students interest was very good</td>
<td>Was able to solve a lot of sample questions</td>
<td></td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th></th>
<th>Taught traditionally during the observation traditionally despite the fact that she stated to use the computer from time to time</th>
<th>Looking glasses</th>
<th>Average Students’ interest</th>
<th>Was able to solve a small number of sample questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Taught traditionally but used computer only while solving sample programs</td>
<td>Movement on an inclined plane</td>
<td>Average Students’ interest</td>
<td>Was able to solve a small number of sample questions</td>
</tr>
<tr>
<td>G</td>
<td>Taught traditionally</td>
<td>Straight movement</td>
<td>Little Students’ interest</td>
<td>Was able to solve a small number of sample questions</td>
</tr>
<tr>
<td>H</td>
<td>Taught traditionally</td>
<td>Liquid pressures</td>
<td>Little Students’ interest</td>
<td>Was able to solve a small number of sample questions</td>
</tr>
</tbody>
</table>

SEMI-STRUCTURED INTERVIEW FINDINGS

Interviews have been conducted with the teachers observed. Questions regarding the following have been directed at the teachers;

a) Why did they prefer to use computers in their classes
b) What was the contribution of using computers in their classes
c) When did they start using computers in their classes

To the teachers who had stated that they used computers in their classes rarely or never questions like those below were asked;

a) Why did they use computers rarely or never
b) The difficulties that they have had while using computers

teacher A: He mentioned that he used the computer almost in all of his classes. His interest to use the computer in his classes had begun during his B.A. years. This teacher taught electric circuits and the brightness of lamps using a simulation. Student’s comprehension of the topic could be understood from the right answers they provided to the teachers question. He was able to cover the topics to be taught in 4 hours only in two and had just made ample time to solve more questions.

teacher B: He expressed that the computer should be incorporated more in educational settings and that he was capable for doing that. He taught electromagnetic induction using a package program. He was able to answer many questions and had enough time to turn back to the topics that were either misunderstood or not understood at all. He stated that he had established many question banks and that these were very useful during the lesson.

teacher C: The reason for using a computer in the class; he was interested in using technology, this was easy for him, and this interest was aroused during his college years. He expressed that he used computer presentations during the projects that he has had in those years. His self esteem could be felt throughout the observation.

teacher D: On being asked why he used a computer in his classes he said; “this is easier for me and I do not want to lose time drawing figures on the blackboard”. He further mentioned that his parents bought him a computer while he was at middle school and he had first played games before he started writing programs. He kept the interest of his students alive and solved many questions throughout the class.

teacher E: She stated that he used a computer from time to time in her classes and preferred using it mostly while answering questions. The reasons for that were rooted because of her concern loosing face in front of the students as she deemed herself insufficient in using computers. Moreover, as there were not computers in every class, she could not keep pace with the topics among her classes.

teacher F: She stated her reason for using a computer rarely as follows: “In one of my classes while using it the computer broke down and as I could not fix it at that moment. As I felt humiliated in front of my class, I now refrain from using the computer for presentation but prefer it for solving questions in the class. As this teacher was turning her back to the class while explaining the topic, her classroom management was weak.

teacher G: The reason for not using the computer was mentioned as the lack of practice in the computer and technology classes throughout her college years and the in-service courses hampering her to develop her computer skills. She mentioned that she felt the necessity for using a computer in all of her classes and wants to participate in a course. This teacher spent most of her time on formulas and inclined shot drawings leaving her little time to solve questions.

teacher H: Though the use of computers is necessary, he expressed that due to his old age, it was difficult for him. As the students were always much better than him, he always thought twice before, bringing the computer into the class. This teacher, as he was very experienced, taught well in the class without any computer support, but lost time as he had to redraw some of the figures as one of the students could not understand the topic.
said: “If I had been using a computer, I would not have had to redraw and would have more time to answer questions.”

In the interviews with other teachers, they stated the following.

- Teachers are aware of the impact of technology on learning.
- Teachers with a solid background of computers stated the reason for not using the computer as the lack of overhead projectors in the classes and lack of time,
- Lack of package programs for physics education,
- Probability of difficulties in classroom management if computers are used,
- Use of computers only for individual needs,
- The lack of internet connection at home, the negative effect the limited computer and internet possibilities at the private teaching institution classes.

RESULTS AND DISCUSSION

According to the results of the present study; physics teachers working at private teaching institutions do not have sufficient computers for instruction and teaching in these institutions, only 27.5% have a special interest in computers, 55.0% consider computers to have a positive impact on students learning, and among the participants only 17.5% have always computer supported physics classes. Besides, all the teachers have had computer related instruction during their college years mostly limited with two hours and 57.5% consider the education that they received as insufficient. 57.5% of the teachers deem in computer supported physics classes visualization as dominant and, 45.0% the retention of information as dominant compared to other methods.

In a similar study, Sarı (2010) indicated that 57.0% of teachers know usage of computer at intermediate level, 20.0% of them know at upper-intermediate level and 22.0% of them know at beginner level. It was also determined that 27.0% of these teachers do not use computer in their lectures, 20.0% of them use it once a week, 26.0% of them use it once a month and 15.0% of them use it once a term.

In the research of Çağlıyaoğlu et al. (2001), it was determined that 41.0% of teachers never use computers and 20.0% of them have a computer usage experience more than two years. 56.0% of teachers indicated that they are very interested in learning the usage of computers, 42.0% of them are moderately interested and 2.0% of them are not interested in learning. 21.0% of the teachers stated that they were participated in-service training related with computer usage.

According to $\chi^2$ (Chi-square) analysis results, there was not a significant difference ($p > .05$). Between the level of computer usage and; Gender, number of students per computer in the classes, the existence of somebody or some institutions that they could turn to if they had any problems in using computers, seniority.

Azar and Akdeniz (2006), found in their research that seniority did not have an effect on computer usage. A similar study conducted with natural sciences and technology teachers revealed that there was not a meaningful relation between seniority in the profession and use of computers (Karamustafaoğlu, 2006). Contrary to these studies, (Ağır et al., 2006) found that the use of internet had a significant relation with seniority. The attitude of teachers with (0-5 years) seniority was higher than that of their older colleagues.

In the present study, similar to the research conducted by Karamustafaoğlu (2006) there was not a significant relation between gender and teachers’ computer usage. However, Akpmar and Turan (2002) found out that male teachers used more teaching materials compared to their female counterparts. Regarding teachers’ computer usage in the present study there was a significant relation between; Teachers interests in computers, considering computers as technological devices facilitating learning and participation in computer courses ($p < .05$).

Haldeman (1992) determined in his research that most of the teachers would like to use technology better in their lectures and they developed positive manner. Özdemir and Tabak (2004) determined in their research that application of computer-aided education method in mathematics lecture of primary school increased the student success and positive manner towards mathematics. Çağlıyaoğlu et al., (2001) indicated in their research that believes of teachers about computer usage were positive and they believed that computer usage in education would increase the quality of education and would not bring additional work load. Moreover, most of the teachers participated in the research advocated that computers increased the success of students in lectures as 91.0%, their interests as 92.0% and their motivations as 89.0%. In the research of Güveli and Baki (2000), it was determined that teachers had a belief about computer-aided mathematics lecture would not be as desired as long as university entrance exam in the education system of our country is present. However, it was also stated that computer-aided education might be interesting, motivating and might have an important effect in simplifying learning of students. İşman (2002), determined in his research that teachers do not use sufficiently motivating and
increasing education technologies in education system for learning. In the research of Kılıç (2010), it was determined that most of teacher candidates feel themselves competent in terms of using education technologies. So all of these outcomes clearly show the reasons for using or not using computer supported physics classes.

According to the observation and interview results it can be stated that; Teachers A, B, C, and D make use of computers due to individual needs. They expressed that they could make use of computers in every occasion. They have self esteem and manage time well. The common features of four teachers were; efficient use of computers for personal use, use of computers as means of presentation, and while preparing lecture notes for their students.

The present study reveals that the level of computer use by the teachers is below the level desired. Parallel results are obtained from the relevant literature (Alev, Yiğit, 2006; Cosgrove, 1995; Davis & Speer, 1990; Streeter, 1978; Ivers, 2002; İşman, 2003; Karamustafaoğlu, 2003).

Factors having a negative impact on the use of computers and related instructional technologies are as mentioned by many researchers (Byrom, Bingham, 2001; Granger et al, 2002) ; insufficient development of the staff, insufficient technological support, lack of access to hard and software, lack of grants and support for the teachers to improve themselves in this particular field. So an important finding of the present study is that despite the fact that the majority of the physics teachers have attended computer courses they consider themselves insufficient in the use of computers.

The results of this study can be summarised as given below;

- It was determined that There aren’t adequate computers in training centers for the aim of education, Few teachers are sensitive to computer usage, Very few teachers always give computer-aided physics lectures, Teachers take lectures related with computer during their undergraduate education however they think that this is inadequate, More than half of the teachers think that doing computer-aided physics lectures will increase their visual quality, Almost half of teachers stated that doing computer-aided lectures will provide permanence of information more than other methods,
- It was determined that the computer usage levels of teachers do not depend on; Gender, Number of students per computer in the class, Presence of people and institutions who will guide them when there is a problem in their computer usage, Professional seniority.
- A significant difference was found between computer usage of teachers in physics lectures and their interest in computers, for them to think that computers are technological devices supporting learning, and their situations about participating in computer courses.
- It was determined about teachers who were observed and interviewed that: Teachers, always doing computer-aided physics lectures, Also use computers quite effectively in their personal needs, Make their lecture presentations with computers in the classroom, Benefit from internet and other software while preparing course grades for students.
- It was concluded that the computer usage levels of teachers are generally not at desired levels, They feel themselves unqualified although they participated in courses related with computer education, They couldn’t get enough technical support, They do not have access opportunities for equipments and software related with every subject.

As a result, if teachers overcome the barriers caused by their personal worries, they will be efficient users of technology in learning environments.

SUGGESTIONS
According to the findings of this study the suggestions below can be given:

- In-service teacher education programs are to be designed and teachers educated for the use of ICT in the learning process.
- Teachers are to be provided with sufficient technical support for the use of computers in the classes.
- Awareness for the incorporation of teaching materials should be raised in teachers and they should be encouraged to do so.
- The amount of the computers in the private teaching institutions should be increased in order to answer the demand.
- Teachers should be made self reliant in term of knowledge, skills, and equipment for the development of the materials required in the classes.
REFERENCES


GENDER DIFFERENCES IN USING SOCIAL NETWORKS

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ABSTRACT
The purpose of this study is to determine individuals’ usage purposes of social networks with a focus on the possible differences between females and males. Facebook, which is one the most popular and being most widely used social network, is investigated in this study. The study group consisted of 870 Facebook users who responded an online survey designed by the researchers. Analyses of the results showed that usage purposes can be categorized under four categories, namely maintaining existing relationships, making new relationships, using for academic purposes and following specific agenda. Significant differences were found between genders in all of the purposes mentioned. While the difference on making new contacts was in favor of males, the differences on the other three user purposes were in favor of females.

Keywords: Social networks, Facebook, gender differences, usage purposes

INTRODUCTION
Social networks have become a global phenomenon and attracted extensive population from all around the world in different ages, cultures, education levels, etc. In addition to routinely checking e-mails, reading daily forums and newspapers or following instant message tools, people now also check their social network profiles by following others’ status changes, updating their profiles or looking at others’ profiles. Research has shown that many people connect to social network sites at least once a day either to check their profiles or to participate in different online activities (Joinson, 2008; Lenhart, 2009).

Social networks are defined as a body of applications that augment group interaction and shared spaces for collaboration, social connections, and aggregates information exchanges in a web-based environment (Bartlett-Brag, 2006). Facebook, Myspace, Youtube, Flickr, and LinkedIn are the most commonly known social network sites containing similar as well as different features. Facebook is handled among other social networks in this study because of being the most popular and most heavily visited social network website (eBizMBA, 2010). Facebook is defined as “a social utility that helps people share information and communicate more efficiently with their friends, family and coworkers” (facebook.com). Despite the fact that Facebook was launched in 2004 as a Harvard-only Social Network site, it expanded to include other high school students, professionals inside corporate networks, and eventually everyone who have access to the online world (Cassidy, 2006). Facebook provides an opportunity to users, to create personalized profiles that include general information like education background, work background, and favorite interests and also to add links and song clips of their favorite bands, post messages on friends’ pages, and post and tag pictures and videos, among other things (Rosmarin, 2007; Zywica & Danowski, 2008).

People use social network sites for a variety of reasons among which ease of use, allowing rapid updating, analyzing and sharing the continuously increasing information, reflecting on daily life, establishing and maintaining spontaneous social contacts and relationships, supporting informal learning practices with interaction and communication and facilitating delivery of education are the leading ones. Thus, these reasons explain why social network sites are adopted rapidly although they first had emerged with the purpose of sharing photos, personal information, videos, profiles and related content (Mejias, 2005; Ajjan & Hartshorne, 2008).

Most of the social network users are young individuals most of whom are university students. Hence, social network sites are considered to play an active role in younger generation’s daily lives (Lenhart, 2009; Koca 2009). The relationship between the youth and their involvement in social network sites has attracted many research that focused on young people’s social network activities in relation to their privacy concerns as pertaining in their social network usage (Lenhart & Madden, 2007; Pempek, Yermolayeva & Calvert, 2009; Zywica & Danowski, 2008). Similarly, comparisons of different social networks in terms of their features and users’ demographics such as gender, frequency of use and their reasons for participating in social network environments remain as the most popular research areas.

It is stated that as social networks facilitate the sharing of photos and videos with both real world as well as virtual friends while allowing them to build unique online identities by customizing their personal profiles with a range of multimedia elements that are open to others’ reading (McLoughlin & Lee, 2007). Because individuals come together around shared and common goals or needs willingly in social networks, especially, tendency to
building new communities and groups or participating in them comes up. In these environments, individuals move from being passive consumers to fully functioning members by sharing their materials and views with others with whom they reach sensible conclusions. Hence, this cooperative activity helps members to shape the group identity in addition to their individual identities (Atwell, 2006).

It is important to reveal individuals’ social network usage purposes, usage areas and outcomes to understand what motivates them to adopt social networks so rapidly and to use so actively. Various researchers have studied users’ purposes in using social networks. Stutzman (2006) stated that social networks can be used for passing time, learning about other people, maintaining social relations, following changes at the university, class or school enrolled. On the other hand, Ellison, Steinfield & Lampe (2007) explained that social network can be oriented towards work-related contexts, establishing new relationships, or reaching those with shared interests such as in music or politics. Lockyer & Patterson (2008) also showed that users can share their personal information with the help of their profile page, connect with other users, upload, tag and share multimedia content they have created, link others to a variety of accessible content, initiate or join sub-sets of common interest groups. Grant (2008) also acknowledged that social networks such as Facebook, MySpace, YouTube, weblogs, as well as wikis are predominantly used by teenagers and young adults as an extension of their personality to show their friends and the world who they are, what they care about, and with whom they are like-minded. According to Joinson (2008), people use social networks to keep in touch with old friends, find the lost contacts, communicate with the like-minded people, join groups with shared interests, organize or join events, view and tag photos, share/post photographs, play games, update one's own status, see others' status. He also grouped these uses under seven categories which were to keep in touch, passive contact, social surveillance, re-acquiring lost contacts, communication, photographs, designing related uses, perpetual contacts and making new contacts. Lenhart (2009) further argued that social networks are primarily used for establishing and maintaining personal or professional contacts, making plans such as by organizing an event or a cause, and simply flirting. Mazman & Usluel (2009) suggested that usefulness, ease of use, social influence and innovativeness can be considered as direct factors influencing usage of social networks whereas facilitating conditions, subjective norms, image and community identity can be accepted as indirect factors.

When examined studies about usage purposes of social networks above, it can be suggested that, most of the studies stated that, people maintain their relations with social networks in which they formed or joined new networks to make new friends. It is noticeable that people generally tend to keeping in touch with friends, maintaining their relations, making new friends, building groups with people around common background (graduated school, department and class groups) or building new groups or joining groups with people which they have shared interest or needs (Mazman & Usluel, 2010; Pempek, Yermolayeva & Calvert, 2009). In this study, Facebook, being one of the most commonly used social networks is studied in relation to usage purposes with a focus on if gender has an effect on these users’ purposes.

**METHOD**

**Participants**

The study group is consisted of 870 Facebook users who responded to the online survey accurately. The web address of the survey was spread out in Facebook and people who took the survey forwarded the survey's link to their friends voluntarily. In addition, link of the survey was displayed on the various Facebook groups' wall to access an extensive crowded people. The survey was available on the web for four weeks. All of the surveyors participated voluntarily to this research and any reward or prices promised.

The study group has showed that most of the participants were 18 to 25 ages (74.4%) and were university students (73.6%) while 94.2% of them are members of at least one of the Facebook groups. As can be seen in Table 1, majority of male users are undergraduate students whereas most of the graduate students who use Facebook are females.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Educational Level</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High school</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>Male</td>
<td>36</td>
<td>339</td>
</tr>
<tr>
<td>Female</td>
<td>34</td>
<td>296</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td>635</td>
</tr>
</tbody>
</table>

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Data Collection Tool

Data were collected by means of an online survey which was developed by the researchers. The survey consisted of two sections. In the first section, demographic characteristics of Facebook users were collected. The second section of survey consisted of 12 items whose responses varied from 1 (Never) to 5 (Always) in form of a five point Likert type scale. In order to ensure the validity of the data collection tool, 7 experts’ views were collected. Based on the feedback received from the experts, the scale was modified and finalized.

An explanatory factor analysis was also employed to determine the item factor loads and to ensure the construct validity of the data collection. In this process, items with low factor loads and those which could be placed under two different factors were specified and one item, (A12) was extracted from the scale. The Cronbach’s alpha value of this 11- item scale was found to be .802 showing that this scale could be considered as a reliable data collection tool within the context of the study.

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The explanatory factor analyses (see Table 2) helped extracting the principal components of Facebook usage in 11 items among which only four factors with Eigen values higher than one were selected (3. 877; 1.521; 1.172; 1.014). These 11 items were distributed under four factors and five items, namely A1, A3, A4, A6, A8 were placed under the first factor, namely “maintaining existing relationships” which included finding old friends and maintaining existing friendships. Two items, namely A2 and A5 were placed under the second factor called “making new relationships” which included making new friends, joining new groups, or building new groups with people around shared interests and needs. A7 and A9 were placed under the third factor which included the activities such as projects, studies, research or homework, and this factor was called “academic usage”. Lastly, two items, namely A10 and A11 were placed under the fourth factor and included activities such as following changes in daily life, following innovations having fun and wasting time. This last factor was called ‘following agenda’.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Item</th>
<th>Factor Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintaining existing relationships</td>
<td>A1</td>
<td>.734</td>
</tr>
<tr>
<td></td>
<td>A3</td>
<td>.767</td>
</tr>
<tr>
<td></td>
<td>A4</td>
<td>.498</td>
</tr>
<tr>
<td></td>
<td>A6</td>
<td>.662</td>
</tr>
<tr>
<td></td>
<td>A8</td>
<td>.538</td>
</tr>
<tr>
<td>Making new relationships</td>
<td>A2</td>
<td>.901</td>
</tr>
<tr>
<td></td>
<td>A5</td>
<td>.680</td>
</tr>
<tr>
<td>Academic Usage</td>
<td>A7</td>
<td>.863</td>
</tr>
<tr>
<td></td>
<td>A9</td>
<td>.801</td>
</tr>
<tr>
<td>Following Agenda</td>
<td>A10</td>
<td>.908</td>
</tr>
<tr>
<td></td>
<td>A11</td>
<td>.886</td>
</tr>
</tbody>
</table>

While a total number of four factors emerged, these explained 68.951% of the total variance. The variance accounted for by the first factor, maintaining existing relationships, being the highest proportion, is 35.244%, following this, variance accounted by third factor, academic usage, is 13.831%, variance accounted by fourth factor, following agenda, is 10.653% and by the lowest proportion, variance accounted by second factor, making new relationships is 9.22%.

As a result of factor analysis, individuals’ Facebook usage purposes are grouped mainly under four factors, namely; “maintaining existing relationships”, “making new relationships”, “academic usage” and “following agenda”.

FINDINGS

The mean scores attained from the surveys were calculated to determine the purposes of Facebook users in using it. As can be seen in Table 3, maintaining relationships, as a factor containing A1, A3, A6, A8 and A4 has the highest mean score. Item A1 (I use Facebook to find my old friends) was found to be the leading purpose having the highest mean score. While A10 and A11 (items about the “following agenda” factor) followed these, item A9 (I use Facebook to support my academic work) has the lowest means score.
Table 3: Facebook Usage Purposes Items with Mean Scores

<table>
<thead>
<tr>
<th>Item</th>
<th>Item Description</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>( \bar{x} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>I use Facebook to find my old friends.</td>
<td>870</td>
<td>1</td>
<td>5</td>
<td>4.09</td>
</tr>
<tr>
<td>A2</td>
<td>I use Facebook to contact with my friends.</td>
<td>870</td>
<td>1</td>
<td>5</td>
<td>4.00</td>
</tr>
<tr>
<td>A3</td>
<td>I use Facebook to share information and resources with my friends.</td>
<td>870</td>
<td>1</td>
<td>5</td>
<td>3.26</td>
</tr>
<tr>
<td>A4</td>
<td>I use Facebook to maintain my relations by joining academic groups (class, school, department and faculty).</td>
<td>870</td>
<td>1</td>
<td>5</td>
<td>3.54</td>
</tr>
<tr>
<td>A5</td>
<td>I use Facebook to follow changes and improvements about my school and school friends.</td>
<td>870</td>
<td>1</td>
<td>5</td>
<td>3.29</td>
</tr>
<tr>
<td>A6</td>
<td>I use Facebook to make new friends.</td>
<td>870</td>
<td>1</td>
<td>5</td>
<td>2.02</td>
</tr>
<tr>
<td>A7</td>
<td>I use Facebook to find out people with common interests and to join groups with such people.</td>
<td>870</td>
<td>1</td>
<td>5</td>
<td>2.55</td>
</tr>
<tr>
<td>A8</td>
<td>I use Facebook to share my homework and projects with my classmates.</td>
<td>870</td>
<td>1</td>
<td>5</td>
<td>2.16</td>
</tr>
<tr>
<td>A9</td>
<td>I use Facebook to support my academic work.</td>
<td>870</td>
<td>1</td>
<td>5</td>
<td>1.92</td>
</tr>
<tr>
<td>A10</td>
<td>I use Facebook to follow the changes occurring in our daily lives.</td>
<td>870</td>
<td>1</td>
<td>5</td>
<td>2.73</td>
</tr>
<tr>
<td>A11</td>
<td>I use Facebook to keep track of innovations on the agenda.</td>
<td>870</td>
<td>1</td>
<td>5</td>
<td>2.46</td>
</tr>
</tbody>
</table>

To determine if Facebook usage purposes differs in terms of genders, t-test analysis was carried on the total scores by factors.

Table 4: t test of Facebook Usage Purposes in terms of genders

<table>
<thead>
<tr>
<th>Usage Purposes</th>
<th>Gender</th>
<th>N</th>
<th>( \bar{x} )</th>
<th>df</th>
<th>Cohen d</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintaining Existing Relationships</td>
<td>Male</td>
<td>446</td>
<td>17.5</td>
<td>4.02</td>
<td>0.365</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>424</td>
<td>18.9</td>
<td>3.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making New Relationships</td>
<td>Male</td>
<td>446</td>
<td>5.0852</td>
<td>2.03937</td>
<td>0.552</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>424</td>
<td>4.0212</td>
<td>1.80150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic Usage</td>
<td>Male</td>
<td>446</td>
<td>3.8767</td>
<td>1.92220</td>
<td>0.209</td>
<td>.002</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>424</td>
<td>4.2925</td>
<td>2.05350</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Following Agenda</td>
<td>Male</td>
<td>446</td>
<td>4.7848</td>
<td>2.11646</td>
<td>0.375</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>424</td>
<td>5.6085</td>
<td>2.27901</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As seen in Table 4, significant differences were found between males and females in their Facebook usage purposes. According to these results, females use Facebook for ‘maintaining existing relationships’, ‘academic usage’ and ‘following agenda’ more than males do while males only use Facebook for ‘making new relationships’ more than the females. To figure out the standardized difference between the two means, Cohen’s d effect size was calculated. The effect size between 0.2 to 0.5 was classified as small, between 0.5 to 0.8 as medium and above 0.8 indicated the large effect size. Examining Cohen’s d effect size showed that the most significant difference was in making new relationships (d=0.052) while the least significant difference was in academic usage (d=0.209).

DISCUSSION
This study revealed out the usage purposes of social networks with a focus on the differences between females and males. The explanatory factor analysis was carried out and individuals’ Facebook usage purposes were categorized under four categories; ‘maintaining existing relationships’, ‘making new relationships’, ‘academic usage’ and ‘following agenda’.

It was found that, people most generally use Facebook for maintaining existing relationships. As Facebook gives users an opportunity to communicate with their friends via messages or chat and also, to track their friends’ status messages, walls and other profile changes, people tend to benefit from these facilities of Facebook. Similarly, in line with this study, Joinson (2008) categorized individual’s social network usages under seven categories, namely ‘social connection’, ‘shared identities’, ‘photographs’, ‘content gratifications’, ‘social investigation’, ‘social network surfing’ and ‘status updates’, and found that the most important uses of social networks are related to social connections which includes ‘finding out what old friends are doing now’, ‘re-acquiring lost contacts’, ‘connecting with people you otherwise would have lost contact with.’ Joinson’s (2008) study support this study’s findings on bases of the social connection factor which reflects the ‘maintaining existing relationships’ factor that was found to be the leading purpose of users in this study. In addition to this, ‘social network surfing’ and ‘social investigation’ factors which include statements such as meeting new people, looking for specific types of people, and looking at the profiles of the people unknown to the user overlap with the “making new relationships” factor of this study.

As people in Facebook, share news from newspapers, TV or magazines and also announce advertisement of innovations, new products or event notifications related to concerts, films, theaters, sport activities etc, ‘following agenda’ factor was found to another most important usage purpose. Once again a similar factor revealed out in Joinson’s (2008) study as ‘content’ and ‘status update’ factor.

Lampe, Ellison & Steinfield (2006) pointed at the distinction between the use of Facebook for social searching (finding out information about offline contacts) and social browsing (the use of the site to develop new connections). With a survey of over 2000 students, he found that the primary use of Facebook was ‘social searching’ that is, using Facebook to find out more about people who they have met offline, or who they attend class or share a dormitory with. The use of Facebook for ‘social browsing’, for instance, to meet someone via the site with the intention of a later offline meeting, or to attend an event organized online, scored relatively low amongst their sample. Lampe, Ellison & Steinfield (2006) also reported that their sample preferred “keeping in touch with an old friend or someone known from high school, university, etc. Similarly, in this study, the findings showed that users make a distinction between maintaining existing relationships and making new relationships, the former being the main purpose of the users with whom the study was carried out.

Lenhart (2009) found that individuals use their social network profiles mostly to ‘stay in touch with friends.’ On the other hand, other social networks usages were accepted as making plans with friends, making new friends, organizing events or causes, making new business professional contacts, promoting work and flirting which are similar to the findings of this study’s factors of ‘academic usage’ and ‘making new friendships’.

Furthermore, it is found that individuals use Facebook mostly for ‘finding old friends’. This finding can be related with the fact that people can search for their old schools, business corporations, and classes without needing their telephone numbers, addresses, e-mails or the city or country in which they live, or simply by writing their names and surnames in Facebook. On the other hand I use Facebook to contact with my friends and I use Facebook to maintain my relations by joining academic groups (class, school, department and faculty) have been revealed out as the other statements that have higher mean scores. This finding indicating that the majority of users claim to use Facebook to contact with their friends and to maintain their relations by joining academic groups shows how individuals’ communication with those with common background or interests are facilitated with various Facebook features as chat, messaging, message walls. Interactivity can be said to enable this interaction which in return affects users’ purposes while becoming a more popular and inviting online application.

Females use Facebook for maintaining existing relationships, academic purposes and following agenda higher than males while males use it for making new relationships at a rate higher than the females’. This finding shows that males use social networks mostly for making new friends and relationships while females use it mostly for finding their old friends and keeping in touch with the existing ones. The reasons for this finding could be explained by the possibility that females tend to hide their identities and personal information to keep their privacy in Internet environment. Research shows that females don’t disclose themselves to people they don’t really know because of social pressure and traditional social roles associated with women (Bölükbaş & Yıldız, 2005; Fallows, 2005). Similarly, Mazman, Usluel & Çevik (2009) found that social influence on the decisions of
females is higher than personal decisions while personal decisions are more dominant over social influence in males. This finding is in line with Tüfekçi’s (2008) study which shows significant differences between males and females on the usage of social networks that females are more likely to use social networks to keep in touch with friends either living nearby or in other schools while males are more likely to use social networks to find potential friends and find people with have similar interests. Thelwall (2008) and Lenhart & Madden (2007) found that males tend to make new relationship in social network environments more than females do. On the other hand, Korkut (2005) found that females’ communication skills are more positive than males’ and he explained this by suggesting that females are more social than males. In our study, however males were found to be more open to new relationships just as communication skills are important both for maintaining existing relationships and making new relationships. Hence, findings of this study do not support Korkut’s (2005) study on females and males in terms of their communication skills.

Social networks have millions of users whose numbers increase rapidly. In this study, usage purposes of social networks are aimed to explain the important role of these sites in people’s daily lives. 18-25 age group who are main common users, were found to be dominant users of social networks in most of the usage factors than other age groups. On the other hand in terms of genders, only in ‘making new relationships’ factor, males found to having higher scores than females. Hence, future research should investigate the reasons why females don’t disclose themselves in internet environment as much as males do beside to the reasons affecting this reality. In addition to this, an another statement must be investigated is why female behave uncomfortable when they are communicating in online environments, while males tend to gain social status and image by sharing their photos and personal characteristics with others to make new relations. Also, usages of social networks should be studied in terms of different variables such as educational level, profession, cultural differences, etc., while the possible sources of these differences can be examined in an in-depth manner.

REFERENCES


METACOGNITIVE SKILLS DEVELOPMENT: A WEB-BASED APPROACH IN HIGHER EDUCATION

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ABSTRACT
Although there were studies that presented the applications of metacognitive skill training, the research on web-based metacognitive skills training are few. The purpose of this study is to design a web-based learning environment and further examine the effect of the web-based training. A pretest-posttest quasi-experimental design was used in this study. Fifty-three college students were assigned into experimental and control groups. After four-week training period, the results of paired-samples t-test showed that experimental group’s posttest scores were significantly higher than the pretest scores in self-plan, self-monitor, and total score, while there was no significance in the control group. In addition, students in experimental group made significantly greater gains compared to control group in self-plan. Discussion and suggestions are also provided.

Keywords: metacognitive skill, web-based training, metacognition, higher education, self-plan, self-monitor, quasi-experimental design

INTRODUCTION
With the rapid development of information diffusion technologies, students can use the Internet, multimedia, and other digital instruments to acquire new knowledge with ease. However, in face of diverse e-learning environments, how they can choose useful information and monitor their self-learning process is an issue that educators should pay attention to. From a review of 179 papers on learning achievement, Wang, Haertel, and Walberg (1990) discovered that metacognition ranks first among the 200 some factors affecting schooling outcomes. They pointed out that metacognitive skills is the ability to associate important messages with prior knowledge, draw inferences, and monitor or assess personal performance demonstrated in the reading process. Gagné (1985) pointed out that metacognition is a high-level cognitive process and also the ultimate goal of instructions. The goals of instructions are to deliver knowledge and also develop students’ abilities to plan, monitor and even reorganize learning strategies.

According to Bransford, Brown, and Cocking (2000) metacognition and self-modify are important elements for developing effective learning and training. As Flavell (1976) pointed out metacognitive skills can be developed through instruction and learning. Among these researchers, Turner (1989) indicated that the reason why students fail to become active and independent students is sometimes they lack metacognitive awareness and strategies. Azevedo (2005) argued that students’ metacognitive skills can be nurtured through proper arrangement of instructions. Taraban, Rynearson, and Kerr (2000) explored the relationship between metacognitive skills and learning outcomes among university freshmen. They investigated the metacognitive strategies commonly used by the students and which strategies were helpful for their academic performance. Their findings revealed that metacognitive strategies for reading comprehension could improve college students’ academic performance.

According to Wittrock (1986), instructions that can activate students’ metacognitive processes are helpful for improving students’ reading comprehension. Besides, learning transfer can be facilitated if students notice their use of cognitive processes or learn to control these processes. O'Donnell, Dansereau, Hall, and Rocklin (1987) designed a training program with mixed learning strategies to investigate students’ learning outcomes. The training consisted of two sections, including training of basic strategies and training of supportive strategies, which is similar to the training of metacognitive strategies. Their findings showed that students receiving the training exhibited significantly better learning outcomes. Ross and Green (2006) investigated whether college students adjust their study strategies to meet the cognitive demands of testing (e.g. the metacognitive skills). The results suggested that the college students would adjusted their study strategies so that they would be in line with the cognitive processing demands of tests and that performance was mediated by the study strategies that were used. Therefore, teachers should demand cognitive processes in the tests or homework depending on the cognitive level of instructions. Gunter, Easters, and Schwab (2003) proposed that metacognition-based instructional methods can nurture students’ ability to monitor their own cognitive processes. Metacognitive support can enhance effective learning. In addition, metacognitive skills training can help students to prepare for future learning even in environments without scaffolds (Wagster, Tan, Wu, Biswas, & Schewartz, 2007). Artino (2009) and Veenman, Elshout, and Busato (1994) mentioned that offering metacognitive support in a computer-based environment can increase students’ learning effectiveness.
Governor (1999) identified several instructional strategies for designing metacognitive instructions in an online learning environment. These strategies include content map, again technology, interaction button, monitoring and online help, and learning process evaluation. According to Kirsh (2005), a good visual design in the e-learning environment can reduce the cognitive load on students and make their learning of metacognitive skills more effective. In an application of metacognitive skills to instructions, Wenger & Payne (1996) proposed a metacognitive instruction system consisting of seven steps. This system allowed teachers to make use of the monitoring function of metacognition to help students learn in an efficient and meaningful manner. For instance, a graphical browser allows students to be aware of missing information and take actions to make up the loss, which is also a process of metacognition. According to Azvedo (2005), scaffolding students’ self-regulated learning and metacognition during learning in a computer-based learning environment can motivate students to learn from challenging tasks. Hsiao (1997) proposed that not only learning strategies (note-taking, reflective questions, and summarization) but also metacognitive strategies (concept map, advance organizer, and instructional map) should be considered in the design of online instructions. In addition, prompts and pop-up windows should be embedded to encourage use of cognitive strategies among students.

In recent years, some online courses, learning materials, and empirical studies on development of metacognitive skills have been proposed. Most of them were focused on metacognitive skills in science or language learning domains. However, design or application of a website for improving metacognitive skills is seldom discussed (Azevedo, 2005). Additionally, Schraw, Dunkle, Bendixen, & Roedel (1995) and Schraw & Nietfeld (1998) argued that metacognitive skills are domain-general skills rather than domain-specific ones. The purpose of this study is to examine the effect of the web-based training of students’ metacognitive skills in higher education.

**Instructional Strategies to Improve Metacognitive Skills**

Based on previous studies (Puntambekar, Stylianou, & Hubscher, 2003; Valcke, Wever, Zhu, & Deed, 2009), the authors integrated the instructional strategies for web-based metacognitive skills training into four main categories, including advance organizer, concept map, scaffolding, and problem-solving strategies. The concept of advance organizer originates from Meaningful Learning Theory (Ausubel, Stager, & Gaite, 1969), which proposes that when learning new knowledge, students will first associate new knowledge with existing superordinate concepts and attempt to incorporate the new knowledge into their cognitive structure to make the new knowledge a part of their acquired knowledge. Hence, superordinate concepts have the function of assimilating new concepts. Students can learn more effectively if the main concepts of the new knowledge to be acquired can be extracted first and then integrated with their prerequisite knowledge. This process of integrating new knowledge with existing knowledge is called advance organizer.

Meaningful learning takes place only when students’ prerequisite knowledge is related to the learning. In other words, students have meaningful learning only if the instructions comply with their competencies and experiences. For teachers, investigating students’ prerequisite knowledge first and designing materials and offering instructions based on students’ prerequisite knowledge later are important tasks. The difference between meaningful learning and rote learning lies in the fact that rote learning only provides students with isolated messages and does not relate them to the concepts already existing in one’s cognitive structure. Hence, messages offered through rote learning will be easily forgotten and cannot be deeply rooted in students’ cognitive system. In fact, students are already equipped with the ability to associate new messages with existing concepts. When they receive new messages, their cognitive structure provides a ground for new messages to be rooted. The cognitive structure accumulates new messages based on previously acquired messages. The amount of new messages that it can acquire depends on how much it has. In addition, Chiquito (1995) suggested that instructors should use advance organizers in practical instructions. Instructors should understand students’ prerequisite knowledge first and use it as a basis to present new learning materials in a systematic and clear manner, which can help students integrate the new learning materials with their prerequisite knowledge and be prepared for introduction of new knowledge.

A concept map is an effective metacognitive strategy or teaching instrument, mainly because connecting concepts in a hierarchical structure facilitates understanding, clarification, and rectification of concepts (Edmondson & Smith, 1996). Doomekamp (2001) stated that students’ metacognitive skills can be developed using tools that can effectively visualize the problem-solving process, such as concept maps. Kinchin and Hay (2005) mentioned that through drawing concept maps, students can organize, reorganize, and assimilate conceptual knowledge they learn, and their learning will become meaningful if new concepts are connected to existing ones.

Clariana and Wallace (2007) proposed that concept maps can be used as a metacognitive strategy or a heuristic instructional instrument. By drawing concept maps, students can identify and contemplate the relationship...
between concepts and further form a hierarchical framework of these concepts. Therefore, concept maps have been viewed as one of the effective metacognitive tools for promoting meaningful learning. Garrett, Alman, Gardner, and Born (2007) indicated that visualizing lecture information and interpreting diagrams are important metacognitive skills in learning transfer and can be a basis for developing more effective guidelines on evaluating metacognitive skills.

Scaffolding can increase students’ metacognitive knowledge and skills. Providing learning strategies, procedural questions, and structured designs of activities which encompass underlining, note-taking, prompts, inquiries, exercises, checklists or making to-do lists, can scaffold students’ self-awareness and self-modify system (Brophy, 1992; Hertzog & Hultsch, 2000; Kirsh, 2005; Schoenfeld, 1992). Azevedo (2005) argued that effective scaffolds should be able to (a) change students’ mental models, (b) allow students to acquire declarative knowledge between the pretest and the pretest, and (c) record students’ self-regulated learning processes. The scaffolds that support self-regulated learning include planning (setting up sub-goals and activate prior knowledge); monitoring (personal cognitive system, current understanding, the hypermedia system and its content, and motivation of learning tasks), effective and ineffective learning strategies, and methods for solving task difficulties and demand problems. Schoenfeld (1992) suggested that prompting students with procedural questions may help foster greater self-awareness and metacognitive skills. Whipp and Chiarelli (2004) also suggested that proper self-monitor and tracking are important characteristics of computer-based learning.

Kirsh (2005) argued that metacognitive tools provide students with some strategies that can make them more active information processors or allow them to monitor and control their learning activities. He mentioned two effective metacognitive training methods that can improve students’ time management using external resources. First, designers can add reminders, questions and exercises, checklists, and a host of other artifacts to improve students’ tracking of their time and progress. Second, designers can add external aids for students to scan all the questions in advance, select the easiest and most valuable ones to do first, and do questions that may be more time-consuming after they have completed all the prioritized questions.

Metacognitive processes such as self-modify and self-monitor require one’s abilities to develop ideas, affections, and improve problem-solving (Treffinger, Selby, & Isaksen, 2008). The findings suggested that students’ performance in solving academic problems can be effectively improved after receiving metacognitive instructions. It has also been empirically confirmed that integrating metacognitive skills to problem-solving instructions is feasible and effective (Mevarech & Mramarski, 2003). Besides, individuals with better problem-solving abilities were characterized by better metacognitive performance (Pan, 1993). Kramarski and Mevarech (2003) used the metacognitive training method called IMPROVE to develop students’ abilities to raise metacognitive questions, including questions about the nature of a problem, strategies for solving the problem, construction of prior knowledge, and correlation between the prior knowledge and new knowledge. Their participants exhibited significantly better mathematics reasoning and reading comprehension skills after receiving the training.

**RESEARCH METHOD**

**Participants**

A pretest-posttest quasi-experimental design was used in this study. Participants in this study were fifty-three college students from two classes in a private large-scale university in northern Taiwan. One class with twenty-nine students was assigned to the experimental group, and another class with twenty-four students was assigned to the control group. The experimental group has six males and twenty-three females aged from 20 to 22 years old, while the control group has five males and nineteen females aged from 19 to 22 years old.

**Design of Web-Based Training**

The website developed by the authors had four sections, which were (a) self-plan, (b) self-monitor, (c) self-modify, and (d) self-evaluate. Table 1 shows the learning objectives of the four sections.

<table>
<thead>
<tr>
<th>Section</th>
<th>Learning Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-plan</td>
<td>1. Understand the concept of self-plan</td>
</tr>
<tr>
<td></td>
<td>2. Make learning plans</td>
</tr>
<tr>
<td>Self-monitor</td>
<td>1. Understand the concept of self-monitor</td>
</tr>
<tr>
<td></td>
<td>2. Identify the concepts learners do not understand</td>
</tr>
<tr>
<td></td>
<td>3. Find the difficulties of learners’ learning</td>
</tr>
<tr>
<td>Self-modify</td>
<td>1. Understand the concept of self-modify</td>
</tr>
<tr>
<td></td>
<td>2. Find the reasons of learners’ learning difficulties</td>
</tr>
</tbody>
</table>

Table 1. Learning objectives of the four sections
3. Modify learning strategies based on the findings

<table>
<thead>
<tr>
<th>Self-evaluate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Understand the concept of self-evaluate</td>
</tr>
<tr>
<td>2. Find the differences among learners’ performance</td>
</tr>
<tr>
<td>3. Evaluate learners’ performance</td>
</tr>
</tbody>
</table>

According to the previous studies, advance organizers are effective metacognitive tools that can help students gain more structured understanding of new knowledge based on their prior experiences. The case study method which has also been proven effective for metacognitive instructions was adopted in the design of our website. It was integrated into instructions of each section, along with the multimedia content.

**Definition of Metacognition**

- Metacognition could be divided into two levels
  1. Comprehension Level: Metacognition is the knowledge and skill of selecting cognitive strategies and setting goals during the cognitive process.
  2. Experienced Level: Metacognition is the knowledge and skill of self-planning, self-monitoring, self-modifying, and self-evaluating beyond the cognitive process.

Figure 1. Sample screen of advance organizer of self-plan section

Therefore, each section started with the advance organizers, and the themes of the instructions surrounded issues about metacognition, including definition of metacognition, displaying components of metacognitive skills using hierarchical graphics, explanation of each component, and presentation of the learning goals for each section. After advance organizer, students were asked to read and watch a video-based case study followed by an exercise. Table 2 shows the design of the learning activities.

<table>
<thead>
<tr>
<th>Table 2. Design of the learning activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section</td>
</tr>
<tr>
<td>________</td>
</tr>
<tr>
<td>Self-plan</td>
</tr>
<tr>
<td>Self-monitor</td>
</tr>
<tr>
<td>Self-modify</td>
</tr>
</tbody>
</table>
For instance, the first section began with demonstration of a concept map titled *A day of an undergraduate, Chih-chun* (Figure 2).

![Figure 2. Sample screen of case study of self-plan section](image)

In the exercise, students were prompted to use concept map tools to draw a time allocation table for themselves (see figure 3). This exercise was intended to guide students to organize their reflective processes and display their understanding of the learning content.
In the second section, the students were asked to read a descriptive article about how to use comprehension-monitoring skills in learning and design a short-essay test of comprehension of the previous article as exercise. The third section involved application of problem-solving strategies. Students were required to follow the six problem-solving steps in Creative Problem-Solving Model to solve given problems. The fourth section presented a case of assessing one’s interpersonal communication skills. Application of metacognitive scaffolding tools, including summarization and self-evaluate, were embedded in each section. This design was intended to identify a correction direction for learning metacognitive skills and key features of metacognitive skills to increase students’ active participation in the learning processes.

Instruments
The Metacognitive Skills Evaluation Questionnaire (MSEQ) used in this study was developed based on Metacognition Rating Scale for General Biology (MRSGB). The Metacognition Rating Scale for General Biology developed by Wang, Wang, and Wang (2004) consisted of four subscales, including self-plan, self-monitor, self-modify, and self-evaluate. The scale was tested through a series of tests, including expert validity test and construct validity test, before it was used in the formal test. MSEQ contains 6-point Likert scale with 45 items divided into four dimensions: self-plan (e.g. When I am learning, I usually set the goals first, and then decide what should be learned, and learn to what extent), self-monitor (e.g. When I am learning, I usually know whether there is anything I do not understand yet.), self-modify (e.g. I can usually find a better way of learning to improve my learning.), and self-evaluate (e.g. When I know my answer is wrong, I usually try to find out the reason.). The overall Cronbach’s alpha of MSEQ was .92. Table 1 presents the content and the Cronbach’s alpha for each dimension of MSEQ.
Table 1. The Construct of MSEQ

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Definition</th>
<th>alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-plan (12 items)</td>
<td>Students discover or realize the key points in the learning materials, set learning goals for themselves, and understand when and how to use learning strategies in the cognitive processes.</td>
<td>.80</td>
</tr>
<tr>
<td>Self-monitor (14 items)</td>
<td>Students are able to identify which concepts they understand and which they do not or the difficulties they have encountered in learning.</td>
<td>.82</td>
</tr>
<tr>
<td>Self-modify (9 items)</td>
<td>Students are able to identify their learning problems, such as inefficiency of their learning methods or low learning performance, and causes of the problems, and then use better learning methods to improve their learning.</td>
<td>.83</td>
</tr>
<tr>
<td>Self-evaluate (10 items)</td>
<td>Students can evaluate their learning performance in an objective manner and understand the difference between them and others.</td>
<td>.84</td>
</tr>
</tbody>
</table>

Procedure
From the beginning of the semester, students from two classes were assigned into the experimental group and the control group. Before implementation of online instructions, students in both groups were given the MSEQ as pretests. The questionnaire was conducted online. Later, students in the experimental group were given web-based metacognitive skills training in a computer lab once a week. On the other hand, students in the control group were not given any metacognitive skills training. To avoid waste of time due to participants’ unfamiliarity with the interface or the functions of the website, participants were given instructions on how to operate the website before the experiment. Each section consisted of introduction, learning by case, exercises by case, and test and was expected to be completed in one hour. The websites had four sections (one section for each dimension), while the materials were accessible by students after class from their home. After the fourth section ended, students in both groups were asked to answer the MSEQ again as the posttest. For analysis, paired-samples t-test and analysis of covariance (ANCOVA) with the pretest as the covariate were used in this study. The data were analyzed by dimensions, to obtain analysis of specific changes in each dimension that occurred as the effect of metacognitive skills web-based training.

Findings
The results of paired-samples t-test showed that experimental group’s posttest scores were significantly higher than the pretest scores in self-plan ($t=4.257, p<.001$), self-monitor ($t=3.364, p<.01$), and total score ($t=3.753, p<.001$), while there was no significance in the control group. Table 2 showed the means, standard deviation, t value, and Significance of each dimensions of the two groups.

Table 2. Results of Descriptive Statistics and Pair-Samples T Test

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Experimental group ($n=29$)</th>
<th>Control group ($n=24$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Self-plan</td>
<td>3.161</td>
<td>3.509</td>
</tr>
<tr>
<td>SD</td>
<td>0.575</td>
<td>0.587</td>
</tr>
<tr>
<td>Self-monitor</td>
<td>3.180</td>
<td>3.406</td>
</tr>
<tr>
<td>SD</td>
<td>0.569</td>
<td>0.616</td>
</tr>
<tr>
<td>Self-modify</td>
<td>3.621</td>
<td>3.778</td>
</tr>
<tr>
<td>SD</td>
<td>0.617</td>
<td>0.660</td>
</tr>
<tr>
<td>self-evaluate</td>
<td>3.559</td>
<td>3.617</td>
</tr>
<tr>
<td>SD</td>
<td>0.638</td>
<td>0.645</td>
</tr>
<tr>
<td>Total score</td>
<td>3.380</td>
<td>3.578</td>
</tr>
<tr>
<td>SD</td>
<td>0.516</td>
<td>0.577</td>
</tr>
</tbody>
</table>

To examine the effect of web-based metacognitive skill training, ANCOVA was used after pair-samples t test. The results of ANCOVA showed that students in experimental group made significantly greater gains compared to control group in self-plan ($F (1, 50) = 6.4920, p < 0.05$). However, there is no significant differences in self-monitor ($F (1, 50) = 0.033, p = 0.856$), self-modify ($F (1, 50) = 0.089, p = 0.767$), self-evaluate ($F (1, 50) = 0.037, p = 0.849$), and total score ($F (1, 50) = 0.976, p = 0.328$).

DISCUSSION AND CONCLUSION
Although, the results of ANCOVA revealed that students in the experimental group had improved their self-plan skills only after receiving web-based training compared to the control group, we were excited to find that there were significant differences between pretest and posttest in self-plan, self-monitor, and total score in experimental groups while there was no significant difference in control group. In addition, though there was no
significant difference between pretests and posttests in self-modify and self-evaluate in the experimental group, the scores of posttests were higher than the pretests. Moreover, the pretest-posttest differences in self-modify between two groups was not significant but close to the level of significance ($p = 0.086$). This analysis explained that the web-based metacognitive skill training indeed helped students enhance their self-plan and self-monitor skills but could not significantly improve their self-modify and self-evaluate skills. From the results above, we made the following inferences.

First, visualizing strategies, such as concept map and hierarchical mapping, were properly applied in the learning section of self-plan, so participants in the experimental group could exhibit a significant improvement in this metacognitive component. Compared with other sections, this section had three distinct characteristics:

1. Structured—the structure of the knowledge to be delivered was analyzed in advance, and information was displayed with the aid of multimedia to enhance students’ comprehension and memory of the learning materials.
2. Procedural—Concept maps and hierarchical maps were utilized to display how to use metacognitive strategies step by step. These metacognitive tools could effectively make up the gap between imagination and comprehension.
3. Visualized—complicated concepts could be clearly expressed through use of visualizing tools. In other words, visualization of ideas could effectively increase the retention of the ideas in students’ memory.

Moreover, the learning materials provided in our website were not completely conformed to the principles for designing metacognitive instructions, thus resulting in insignificant improvement of the students’ metacognitive skills in some aspects. The inconformity existed in the following aspects,

First, training of comprehension monitoring was insufficient. According to Kirsh (2005), though metacognitive tools could help students monitor their learning activities, learning activities should be designed to be more structured and tangible. For instance, in the training of metacognitive skills for reading comprehension, students should be asked to summarize the article, explain key ideas, construct the context, and analyze the core meaning of the article after reading it. In our self-monitor section, we also asked students to read an article and offered metacognitive tools, such as highlighting, making topic sentences, and summarization. However, we did not let students interpret the key ideas and engage in more in-depth reflective activities, such as drawing a concept map about the ideas they have comprehended, which could allow them to have a better control over their comprehension of the article. Therefore, for better effectiveness in learning self-monitor, we suggest that computer graphics can be more sufficiently exploited in the design of an e-learning website to provide more in-depth reflective training.

Second, social functions were not sufficiently embedded in our website. According to Osman and Hannafin (1992), transfer of metacognitive skills relies on application of social interactions. Manning and Payne (1996) have also mentioned that interactive teaching processes help students improve their self-regulated abilities through free dialogues. We did not let students discuss the learning content with peers or instructors directly. Therefore, we suggest that dialogues and interactions between students or between students and instructors should be considered and emphasized in the design of an e-learning website.

Third, the instructional design regarding self-awareness was insufficient. Based on the self-modify processes (self-observation, self-judgment, and self-reaction) proposed by Schunk (1998) further argued that an individual should be able to observe and understand his or her performance, judge the performance according to personal criteria, and respond to the judgment. After accomplishing one task, one will evaluate his or her performance and then acclaim or criticize the performance on his or her mind. Below is a brief explanation of the three self-modify processes:

The learning activities involved in the self-evaluate section were intended to guide students to develop self-evaluate skills necessary for a job interview. These skills included how to determine if one has correct understanding of the interviewer’s requirement of interpersonal communication skills and how to set up objective criteria for assessing his or her own attractiveness. Due to the limitation of time allowed for each section, we were unable to integrate training on self-judgment of performance and improvement of self-reaction into the instructions. Therefore, for better effectiveness of self-evaluate, we suggest that cognitive processes including self-observation, self-judgment, and self-reaction should be emphasized in the design of a web-based training.
IMPLICATIONS AND SUGGESTIONS

Based on the above findings, we proposed the following suggestions. First, materials about metacognitive skills should be properly utilized as an instructional aid. Our results suggested that integrating materials about meanings of metacognition and usage of metacognitive strategies into online instructions can effectively increase the effectiveness of the instructions. Proper integration of these materials can not only promote students' metacognitive skills but also provide metacognitive strategies that they can use for learning in other domains. Second, in a web-based environment, instructors should pay attention to students’ metacognitive competence and improve their metacognitive competence. Internet provides an environment for self-learning, and metacognitive skills helps students construct knowledge and monitor, regulate, and assess their learning in the cognitive processes. In the promotion of web-based self-learning, instructors should understand that in order to enhance the effectiveness of self-learning, students must be prepared with the basic skills for self-learning, and metacognitive skills offers the core skills required by self-learning. Third, in the design of web-based training, instructors should follow the principles for designing metacognitive instructions and integrate metacognitive strategies to enhance students’ self-learning abilities. Web-based training should be designed according to the principles for designing metacognitive instructions and with integration of metacognitive strategies, such as scaffolding, problem-solving, inquiry, summarization, concept map, and visualization, can enhance students’ metacognitive skills, which is the basic competence required by self-learning. Hence, instructors are advised to refer to the principles in the design of e-learning materials and appropriately integrate metacognitive strategies to promote students’ self-learning abilities.

For the future studies, the principles for designing online metacognitive instructions should be further investigated. In this paper, we reviewed previous literature to induce a series of instructional strategies for designing online metacognitive instructions and applied a portion of the principles to the design of our e-learning materials. However, subject to research objectives and scope, we did not further investigate applications of these principles. Therefore, future researchers can revisit these principles from either a qualitative or a quantitative perspective to explore when and how to use these principles, the advantages and limitations of each principle, and whether there is any exception to the application of these principles.

To increase students’ performance in self-monitor, self-modify, and self-evaluate, more training on structural reflection, social interaction, and self-awareness should be involved in e-learning materials. Due to insufficient time, we were unable to reinforce students’ learning in self-monitor, self-modify, and self-evaluate aspects. We suggested that future researchers integrate activities involving structural reflection, interactions between students or between students and instructors, and development of self-awareness into e-learning materials.

In addition, memory retention and learning transfer should be emphasized in the design of e-learning materials. Our results showed that effectiveness of metacognitive instructions may be affected by retention of meta-memory and learning transfer. In our website, although we used context-based tests to increase students’ meta-memory, we did not evaluate the effect of learning transfer and allow students to review the learning content due to limitation of time. Hence, we suggested that future researchers allocate time for students to review the learning content, so that more memory can be retained. Besides, future researchers can also develop an online test with a set of criteria for evaluating transfer of learning from training materials.

Future studies on application of web-based metacognitive training should extend to other learning domains or cover a broader range of research subjects: We developed a website of metacognitive skills instructions for college students to investigate its effects on learning of metacognitive skills. Our findings confirmed that our application was effective in some aspects. Previous literature has pointed out that metacognitive skills has significant benefits for students in many areas of learning, including mathematics, reading, problem-solving, self-modify, crucial thinking, and creative thinking (Caverly & MacDonald, 2000). Instructors can use Internet as a metacognitive tool to effectively guide students to engage in learning self-analysis, self-judgment, and self-modify (Wijekumar & Jonassen, 2007). Therefore, we suggested that future researcher focus on other learning domains or widen the range of research subjects to explore the effects of integrating metacognitive instructions into e-learning on students’ learning in other domains or on students in different age groups to produce more empirical results.

REFERENCES


OPASS: AN ONLINE PORTFOLIO ASSESSMENT AND DIAGNOSIS SCHEME TO SUPPORT WEB-BASED SCIENTIFIC INQUIRY EXPERIMENTS

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ABSTRACT
Promoting the development of students’ scientific inquiry capabilities is a major learning objective in science education. As a result, teachers require effective assessment approaches to evaluate students’ scientific inquiry-related performance. Teachers must also be able to offer appropriate supplementary instructions, as needed, to students. Scientific inquiry capabilities should be assessed by evaluating students’ scientific inquiry portfolios in actual hands-on experiments. Although virtual laboratory systems can reduce the cost of conducting scientific inquiry experiments, the manual portfolio assessment approach is still difficult and time-consuming for teachers. Therefore, in this paper, in order to provide students with personalized learning guidance concerning not only the conceptual knowledge, but also the high-order, integrative abilities of scientific inquiry, an Online Portfolio Assessment and Diagnosis Scheme, called OPASS, was proposed to assist teachers in automatically assessing and diagnosing students’ abilities as they relate to scientific inquiry performance. Personalized diagnostic reports were generated by employing the rule-based inference approach, which diagnosed learning problems and provided corresponding reasons and remedial suggestions based on teacher-defined assessment knowledge of the scientific inquiry experiment. For the evaluation, experimental results showed that the OPASS was helpful and beneficial for both students and teachers.

INTRODUCTION
Today, Scientific Inquiry (SI)-based learning receives widespread attention. The purpose of such learning is to promote students’ knowledge and understanding of scientific ideas as well as how scientists study the natural world (National Research Council [NRC], 1996). If students possess scientific inquiry skills, they are capable of conducting an investigation, collecting evidence from a variety of sources, developing an explanation from the data, and communicating and defending their conclusions (National Science Teacher Association [NSTA], 2004; Handelsman, et al., 2004). Educators should teach students to learn and acquire not only conceptual knowledge, but also scientific inquiry skills. Consequently, the assessment concerning scientific inquiry is necessary and required to foster knowledge and skills of inquiry-based learning. In general, the traditional paper-and-pencil test is a suitable approach to measure students’ knowledge of science concepts and scientific inquiry, e.g., Substantive Knowledge. However, it is not easy to assess and evaluate learning problems and performance of higher-order capabilities related to scientific inquiry, e.g., Procedural Knowledge, and Problem Solving and Integrative Abilities (Wenning, 2007; Jacobs-Sera, Hatfull, & Hanauer, 2009; Bennett, Persky, Weiss, & Jenkins, 2007, 2010).

Furthermore, scientific inquiry can be considered as a set of process skills that consists of questioning, hypothesis-making, experimenting, recording, analyzing, and concluding, which can be regarded as "hands-on" learning (NRC, 1996, NSTA, 2004; Ketelhut, Dede, & Clarke, 2010). Nevertheless, learning and assessing in the physical laboratory are inconvenient and time-consuming for both teachers and students (Hanauer, Hatfull, & Jacobs-Sera, 2009, pp. 117-118). With this in mind, a significant amount of research has been dedicated to develop the virtual and Web-based interactive learning systems to support online scientific inquiry learning (Yaron et al., 2008; Hsu, Wu, & Hwang, 2008; Dalgarno, Bishop, Adlond, & Bedgood, 2009; Yaron, Karabinos, Davenport, Leinhardt, & Greeno, 2009; Yaron, Karabinos, Lange, Greeno, & Leinhardt, 2010; Ketelhut et al., 2010). Through this type of learning, students can efficiently improve and foster their experiences and skills based on scientific inquiry learning activities, and their portfolios can be collected for the further analysis. Using
students’ portfolios collected from inquiry-based learning activities to manually assess scientific inquiry is an ideal approach (Zachos, Hick, Doanne, & Sargent, 2000; Lunsford & Melear, 2004), but it is not easy to perform and it is time-consuming for teachers (Zachos, 2004; Jacobs-Sera et al., 2009, Hanauer et al., 2009, pp. 117-118, Bennett et al., 2007, 2010).

Moreover, many articles also argue that students should be provided with not only the score of test, but also the individual learning guidance for improving their learning performance. For this reason, several analysis and diagnosis approaches have also been proposed to assess the learning portfolio of students and then offer them the personalized learning guidance related to misconceived notions of a given subject (Hwang, 2003; Kosha, Dimitroca, & Boyle, 2007; Chu, Hwang, & Huang, 2010; Panjahuree, Hwang, Triampo, & Shih, 2010) and scientific inquiry skill scores (Ting, Zadeh, & Chong, 2006; Ting, Phon-Amnuaisuk, & Chong, 2008; Bennett et al., 2007, 2010). Nevertheless, an analysis of learning problems related to scientific inquiry skills needs to diagnose the operational and procedural portfolios so students can understand their learning status and problems in relation to not only scores and concepts, but also to operations and skills of scientific inquiry.

Therefore, in this paper, to provide students with personalized learning guidance concerning not only the conceptual knowledge, but also the high-order, integrative abilities of scientific inquiry, an Online Portfolio Assessment and Diagnosis Scheme, called OPASS, has been proposed. The OPASS is able to efficiently evaluate students’ assessment portfolios collected from the Web-based scientific inquiry experiment. It employs the rule-based inference approach to automatically diagnose learning problems related to concepts, cause and effect operations, and skills of scientific inquiry according to teacher-defined assessment knowledge of the scientific inquiry experiment. Consequently, students can be provided with personalized scientific inquiry diagnostic reports to improve not only subject concepts, but scientific inquiry skills as well.

RELATED WORKS
Assessments of Scientific Inquiry
The knowledge and capabilities of scientific inquiry are multidimensional (NRC, 1996; Wenning, 2007; Hanauer et al., 2009, pp. 11-21) and can be divided into three types: (1) Substantive Knowledge, e.g., scientific concepts, facts, and processes; (2) Procedural Knowledge, e.g., procedural aspects of conducting a scientific inquiry; and (3) Problem Solving and Integrative Abilities, e.g., the ability to solve problems, pose solutions, conceptualize results, and reach conclusions (Jacobs-Sera et al., 2009, p. 36). Therefore, the assessment concerning scientific inquiry is necessary and required to foster inquiry-based learning. Hence, in order to assess the scientific inquiry levels of students, Zachos et al. (2000) proposed critical “scientific inquiry capabilities” as assessment measures, whereby a series of structured performance tasks were designed to investigate students’ competence in conducting scientific inquiry. Zachos (2004) then proposed that the students’ responses, presented with the structured performance tasks, should be recorded and assessed based on scientific inquiry capabilities (Zachos et al., 2000) because the direct observation of performance is not feasible within educational systems and it is time-consuming for both teachers and students (Hanauer et al., 2009, pp. 117-118). A paper-and-pencil, 35-item Scientific Inquiry Literacy Test (SchInqLit), developed by Wenning (2007), is a diagnostic multiple choice test of knowledge relevant for scientific inquiry based on a defined form of scientific literacy. This test can be used to measure students’ scientific inquiry knowledge and it is ideal for the pre- and post-testing measures. However, Wenning (2007) also suggested that SchInqLit should be regarded as an indicator of students’ abilities only because procedural knowledge should be assessed by means of performance tests. Furthermore, based on the concept of avoiding direct assessment of students’ scientific inquiry process knowledge, Lunsford and Melear (2004) used the final product of scientific inquiry activity (e.g., portfolios, laboratory practices, and student demonstrations) to assess and infer the learning status and performance concerning scientific inquiry capabilities of students.

To assess scientific inquiry performance, Hanauer et al. (2009, pp. 39-42) defined the characteristics of the Authentic Scientific Inquiry Assessment (ASIA) and thus proposed the active assessment development procedure, which consists of five stages: (1) Empirical Description of Scientific Inquiry; (2) Definition of Educational Aims; (3) Assessment Tool Development; (4) Scoring Rubric Development; and (5) Assessment Piloting. Based on this development procedure, a case study referred to as the Phage Hunters Integrating Research and Education (PHIRE) program, was proposed to address how specific assessment strategies and tools were constructed and implemented (Hanauer et al., 2009, pp. 55-113). The PHIRE program aims to introduce students to the scientific process, and to emphasize the involvement of students who have little scientific training, but are curious about science and the natural world in which we live. Therefore, it was designed as a 10-step program, consisting of the following: (1) Phage Isolation; (2) Phage Purification; (3) Phage Amplification; (4) Electron Microscopy; (5) Nucleic Acid Extraction and Restriction Analysis; (6) DNA Sequencing; (7) Genome Annotation; (8) Comparison of the DNA Sequence to Known Genome; (9) Comparative Genome Analysis; and...
Publication. These steps are used to train and assess participating students. The PHIRE assessment strategy covers formative diagnostic and summative aims of an scientific inquiry education pertaining to the bacteriophage subject. The strategy includes five assessment tools to assess and evaluate the performance of students’ scientific inquiry skills: (1) the Substantive Knowledge Test; (2) the Physical Checklist; (3) the Visual Literacy Test; (4) the Notebook Assessment Tool; and (5) the Knowledge Presentation Performance Test. Each test consists of either multiple choice questions, open-ended questions, or observations. However, the practical issues of space, time, and money become significant problems to perform the PHIRE program, although it can offer students individual assessment and diagnostic reports of scientific inquiry (Hanauer et al., 2009, pp. 117-118). Conducting the scientific inquiry assessment by means of inquiry-based learning activities related to definitions of scientific inquiry capabilities appears to be an ideal approach (Zachos et al., 2000; Lunsford & Melear, 2004), but it is not easy to perform and it is time-consuming to manually assess the portfolio (Zachos, 2004; Hanauer et al., 2009, pp. 117-118). In addition, it can also be difficult to evaluate learning problems and performance of higher-order capabilities related to scientific inquiry through the use of traditional paper-and-pencil tests (Wenning, 2007; Bennett et al., 2007, 2010, Jacobs-Sera et al., 2009).

Virtual and Web-Based Interactive Learning Environments
Scientific inquiry, as a set of process skills, which consists of questioning, hypothesis-making, experimenting, recording, analyzing, and concluding, can be regarded as "hands-on" learning (NRC, 1996, NSTA, 2004; Ketelhut et al. 2010). Therefore, students need to experience and practice the scientific inquiry-based activity in the physical laboratory in order to efficiently foster and acquire the skills of scientific inquiry. However, practicing in the physical laboratory is not convenient and it is time-consuming for both teachers and students (Zachos, 2004; Jacobs-Sera et al., 2009, Hanauer et al., 2009, pp. 117-118, Bennett et al., 2007, 2010). A significant amount of research has been dedicated to the development of virtual and Web-based interactive learning systems to support online scientific inquiry learning. A virtual laboratory, called ChemCollective (2010; Yaron et al., 2008, 2009), was developed to allow students to design and carry out their own experiments. Therefore, Yaron et al. (2010) created activities, which enable students to use their chemistry knowledge to practice and resolve problems. According to their results, homework using the virtual laboratory with real-world scenarios contributes significantly to learning. In addition, the virtual laboratory can record all student interactions for the further analysis. Dalgarno et al. (2009) also apply the 3D simulated virtual environment, called the Virtual Chemistry Laboratory, which can be used by distance university chemistry students for familiarization with the laboratory. Teaching students to efficiently learn and acquire scientific inquiry skills is not easy for teachers. Therefore, Ketelhut et al. (2010) proposed a novel pedagogy to infuse inquiry into a standards-based science curriculum by means of a Multi-User Virtual Environment (MUVE), called River City, in order to enhance students’ motivation and improve their overall learning performance of scientific inquiry. In this MUVE, students can make observations, pose questions, access information, gather and analyze data, plan investigations, propose answers and explanations, and communicate the results. The experimental results also show that students were able to conduct inquiries in the virtual worlds and were motivated by that process. To improve learning effectiveness, computer simulations, animations, and Web-based interactive content have also been used in many courses and curriculums (Hameed, Hackling, & Garnett, 1993; Windschitl & Andre 1998; Salajan et al., 2009). Hsu et al. (2008) proposed a Technology-Enhanced Learning (TEL) environment to support science learning related to the causes of the seasons, where a Web-based interactive simulation tool was applied to support students’ explorations. Students can test and evaluate their hypothesis and learned concepts. Although the aforementioned virtual and Web-based interactive learning environments can enhance students’ motivation, foster students’ experiences, and improve students’ learning performance, the assessment and diagnosis of an individual student still need to be performed and manually analyzed by teachers according to the collected data within a given student’s portfolio.

Analysis and Diagnosis of the Learning Portfolio
To analyze learning portfolios, Chen, Liu, Ou, and Liu (2000; Chang, Chen, & Ou, 1998) applied decision tree and data cube techniques to analyze the learning behaviors of students and to discover pedagogical rules related to students’ learning performance from Web logs. These logs include the amount of article reading/posting, question-asking, login, etc. According to their proposed approach, teachers can easily observe learning processes and analyze learning behaviors of students for pedagogical needs. However, this approach cannot provide automatic analysis. In order to automatically diagnose learning problems, Hwang (2003) proposed a Concept-Effect Relationship (CER) model to represent prerequisite relationships among concepts of a course, which can be used to evaluate a student’s learning status, which may then, in turn, provide that student with the diagnostic report that not only denotes the score, but also the description of any misconceptions. Afterwards, to solve the problem that a concept might contain a hierarchical structure of knowledge with different degrees of difficulty, Chu et al. (2010) defined an Enhanced Concept-Effect Relationship (ECER) to assist teachers in identifying relationships among concepts and their multiple knowledge levels. They then proposed a learning
diagnosis algorithm to analyze a student’s learning problems and personalized learning guidance was offered. Based on the concept of the ECER model, a multi-expert approach has also been proposed to integrate the opinions of multiple experts in order to obtain high quality relationships between a test item and concept in the ECER model (Panjaburee et al., 2010). To address the problem of generating automatic feedback for teachers, a Teacher ADViser (TADV) system was developed (Kosba et al., 2007). TADV defined the knowledge model based on the concept map of a course in relation to the individual student, group, and class, and then a feedback generation algorithm using the fuzzy approach was proposed to analyze tracking data of students. Consequently, learning feedback, including conceptual learning performance and possible learning suggestions, will be automatically generated for both the teacher and student. These analytical and diagnostic approaches (Hwang, 2003; Kosba et al., 2007; Chu et al., 2010; Panjaburee et al., 2010) previously mentioned are able to automatically analyze a student’s learning portfolio and generate individualized learning guidance and feedback for both teachers and students; only the diagnosis concerning the conceptual knowledge is taken into account.

Considering the automatic assessment of scientific inquiry skills, Ting et al. (2008) proposed a Dynamic Decision Network (DDN) model in the INQPRO, a scientific inquiry exploratory learning environment for learning Physics (Ting et al., 2006), to assess the mastery of two temporal, variable, scientific inquiry skills of students, i.e., Hypothesis Formulation and Variable Identification. The proposed DDN model can be generated dynamically by integrating various INQPRO Graphical User Interfaces (GUIs) in real-time. In the INQPRO system, students are first required to make a hypothesis statement to elucidate their selected scenarios. Afterwards, students can actively interact with GUIs, and an animated pedagogical agent will give them the tailored suggestions and interventions according to assessment results consisting of three mastery levels (i.e., mastery, partial mastery, non-mastery) of two scientific inquiry skills. However, the tailored interventions only considered the limited suggestions in terms of three mastery levels and incorrect GUI operations of two scientific inquiry skills. The various learning problems, concerning conceptual knowledge, cause and effect operations, and skills of scientific inquiry, with corresponding reasons and remedial suggestions, were not taken into consideration.

Additionally, to measure problem solving with technology, the National Assessment of Educational Progress (NAEP) Technology-Based Assessment Project developed a Technology-Rich Environments (TRE) in the domain of physical science surrounding helium gas balloons (Bennett et al., 2007, 2010). In the TRE search scenario, students needed to use a simulated World Wide Web environment to locate and synthesize information regarding scientific helium balloons. Students were then to answer one constructed response question and four multiple-choice questions related to the uses and science of gas-balloon flight. In the TRE simulation scenario that followed, students could use an interactive simulation tool to experiment with solving problems about relationships among buoyancy, mass, and volume. The TRE employed Evidence-Centered Design (ECD) (Mislevy, Almond, & Lukas, 2003) to develop the interpretive framework consisting of student and evidence models for translating the multiplicity of actions collected from each student into inferences. The student model represented a set of hypotheses about the components of proficiency in a domain and thus defined two primary assessment skills: scientific inquiry and computer skills. The evidence model showed how relevant student actions were connected to those assessment skills; evidence was captured by computer and consisted of student actions called “observables.” The TRE used the scoring criteria called “evaluation rules” to assess the accuracy of observables, and used a modeling procedure based on Bayesian networks (Mislevy, Almond, Yan, & Steinberg, 2000) to create the summary scores of skills. Therefore, by means of the TRE assessment process, problem solving capabilities of students can be assessed and scored. Nevertheless, data collected in the assessment portfolio still needs to be manually evaluated by reviewers and detailed diagnoses concerning skill problems must be further developed. The aforementioned research and systems either provide students with limited diagnostic feedback, e.g., conceptual knowledge and summary skill level scores (Ting et al., 2008), or performed the manual assessment (Hanauer et al., 2009; Bennett et al., 2007, 2010). However, analysis of learning problems regarding scientific inquiry capabilities needs to diagnose the operational and procedural portfolio of students. With this need in mind, our main concern is how to propose a novel, online, automatic assessment and diagnosis scheme to efficiently provide students with descriptive diagnostic feedback, corresponding explanations, and remedial suggestions to correct learning problems concerning conceptual knowledge, cause and effect operations, and skills of scientific inquiry.

ONLINE PORTFOLIO ASSESSMENT AND DIAGNOSIS SCHEME

Problem Description

As stated previously, Scientific Inquiry (SI) as a set of process skills, which consists of questioning, hypothesis-making, experimenting, recording, analyzing, and concluding, can be regarded as "hands-on" learning (NRC, 1996, NSTA, 2004; Ketelhut et al. 2010). Although the virtual and Web-based interactive learning systems can be used to enhance learning performance of scientific inquiry (Yaron et al., 2008, 2009,
2010; Hsu et al., 2008; Dalgarno et al., 2009; Ketelhut et al., 2010), to manually assess scientific inquiry competencies according to the students’ portfolios collected from the inquiry-based learning activities is still difficult and time-consuming for teachers (Zachos, 2004; Hanauer et al., 2009, pp. 117-118; Bennett et al., 2007, 2010). Besides, the limited diagnostic feedback, e.g., conceptual knowledge and summary scores of skills (Ting et al., 2008) cannot allow students to thoroughly understand their learning problems in terms of scientific inquiry. Therefore, in this paper, to provide students with personalized learning guidance concerning not only conceptual knowledge, but also with higher-order knowledge of scientific inquiry capabilities (Wenning, 2007; Jacobs-Sera et al., 2009), pressing issues remain about how to efficiently analyze students’ assessment portfolios and automatically offer them the individual diagnostic reports related to concepts, cause and effect operations, skills of scientific inquiry, and related remedial suggestions. The following three issues must be solved:

(1) How to model and define useful and meaningful assessment knowledge, which can be defined by teachers or domain experts, to correctly present conceptual and evaluation knowledge for the assessment of an scientific inquiry experiment.

(2) How to efficiently analyze learning problems according to the assessment portfolio collected by a Web-based scientific inquiry experiment based on the teacher-defined assessment knowledge.

(3) How to generate a personalized diagnostic report concerning any learning problems related to the concepts, cause and effect operations, and scientific inquiry skills to improve the overall understanding of scientific inquiry.

Framework of the Online Portfolio Assessment and Diagnosis Scheme

According to the issues mentioned in previous sections, an Online Portfolio Assessment and Diagnosis Scheme, called OPASS, has been proposed. The OPASS framework is shown in Figure 1. This scheme employ the rule-based inference approach to efficiently and automatically evaluate students’ assessment portfolios of a Web-based scientific inquiry experiment and then diagnose learning problems concerning concepts, cause and effect operations, and scientific inquiry skills according to the teacher-defined assessment knowledge. It can further provide students with personalized scientific inquiry diagnostic reports to improve not only subject concepts, but also scientific inquiry capabilities.

The OPASS includes two phases described as follows:

1. **Assessment Knowledge Definition of Scientific Inquiry Experiment Phase**: In order to correctly assess a student’s portfolio of the Web-based scientific inquiry experiment, the assessment knowledge consisting of (1) **Experiment Knowledge** and (2) **Evaluation Knowledge** must be defined in advance by the teacher, as shown at
the top of Figure 1. Experiment knowledge, defined as the knowledge structure, includes the concept map of a subject and the skill map of scientific inquiry, and is used to represent required concepts and skills that students need to understand and acquire in the scientific inquiry experiment. Therefore, to assess the students’ capabilities of concepts and skills, steps of experiment planning and actions of the operation experiment in the assessment procedure of the Web-based scientific inquiry experiment can thus be associated with experiment knowledge. Moreover, to check the accuracy of the students’ assessment portfolios, evaluation knowledge including the Key Operation Action Pattern (KOAP) and the Assessment Rule (AR) must also be defined. The KOAP is proposed to define the key operational actions and sequences, which influence the correctness of operational data in the operation experiment. Hence, based on the KOAP and the experiment knowledge, the assessment rule is proposed to evaluate the accuracy of the students’ assessment portfolios and to further identify problems related to scientific inquiry.

2. **Online Assessment Portfolio Diagnosis Process Phase:** In order to efficiently provide students with personalized scientific inquiry diagnostic reports, this phase, which consists of three modules, has been proposed to automatically evaluate and diagnose learning problems according to students’ assessment portfolios, then to generate personalized diagnostic reports. The three modules include the following:

- **Evaluation Process:** uses the teacher-defined Assessment Rule (AR) to evaluate the correctness of the student’s assessment portfolio of the Web-based scientific inquiry experiment.
- **Diagnosis Process:** diagnoses learning problems of concepts, cause and effect operations, and skills of scientific inquiry by means of the proposed Diagnostic Rule (DR).
- **Diagnostic Report Generation:** generates the personalized scientific inquiry diagnostic report with descriptions, corresponding reasons, and remedy suggestions of learning problems based on the defined Description Format.

Details of each phase will be described in the following sections.

**Assessment Knowledge Definition of Scientific Inquiry Experiment Phase**

As mentioned above, in order to automatically assess and diagnose students’ scientific inquiry learning problems according to their assessment portfolios of a Web-based scientific inquiry experiment, the assessment knowledge of the scientific inquiry experiment must be predefined by the teacher (Matthews, Pharr, Biswas, & Neelakandan, 2000; Hwang, 2003; Chu et al., 2010; Panjaburee et al. 2010). Therefore, in the OPASS, the assessment knowledge, which consists of experiment knowledge and evaluation knowledge, has been proposed. Figure 2 shows the relation model of assessment knowledge in the OPASS. In the OPASS, each **Experiment Step** of the assessment procedure in the Web-based scientific inquiry experiment and each **Definition of the Key Operation Action Pattern (KOAP)** can be associated with concepts and skills of the teacher-defined knowledge structure. Based on this aforementioned relational definition, the teacher-defined **Assessment Rule (AR)**, represented by the **IF (Condition Setting) THEN (Assessment Function)** rule format, is able to evaluate the assessment portfolios and diagnose conceptual problems, cause and effect operations, and scientific inquiry skills, where the **Assessment Function** uses the **Problem** definition to check whether students have a problem or not for the corresponding experiment step. Each assessment function is also associated with the corresponding **Diagnostic Knowledge** including **Problem Description**, **Reason**, and **Suggestion**, which will be further used to generate the diagnostic reports by the proposed **Diagnostic Rule (DR)**. Each definition of the Assessment Knowledge (AK) will be described in following subsections.
Definitions of the Experiment Knowledge

In order to assess students’ experimental portfolios, the experiment knowledge related to the scientific inquiry experiment need to be defined in advance. Therefore, in the OPASS, two kinds of knowledge structures have to be defined by the teacher: the concept map of a subject and the skill map of scientific inquiry. The former denotes necessary concepts that students need to learn and understand, and the latter denotes the required skills students need to be equipped with in this assessment experiment. The concept map and the skill map used in the OPASS are defined as follows, respectively.

**Definition of the Concept Map (CM):**

\[ CM = (C, R), \]

where:

- \( C = \{c_1, c_2, ..., c_n\} \): \( c_i \) represents the main concept in a subject
- \( R = \{r_{c_1}, r_{c_2}, ..., r_{c_m}\} \): \( r_{c_i} \) represents the Relation Type between two concepts in a CM, where the Relation Type is defined as the **APO**: \( c_i \) is **A Part Of** \( c_j \), or the **PR**: \( c_i \) is **the Prerequisite of** \( c_j \).

Here, the CM, consisting of a set of concepts \( (c_i) \) with two types of relations, i.e., A-Part-Of relations (APO) and Prerequisite Relations (PR), is a hierarchical structure of concepts of a subject. By means of these relational definitions among concepts, learning problems related to subject concepts can thus be found and diagnosed for a student. Figure 3 depicts an example of a partial CM of a Biology Transpiration Experiment, where the concept Phenomenon has three sub-concepts: Transpiration, Photosynthesis, and Capillarity, and prerequisite concepts of transpiration are water transportation and Capillarity.

![Figure 3: Example of a Partial CM of the Biology Transpiration Experiment](image)

**Definition of the Skill Map (SM) for Scientific Inquiry:**

\[ SM = (S, R), \]

where:

- \( S = \{s_1, s_2, ..., s_n\} \): \( s_i \) represents a Skill of Scientific Inquiry Skills.
- \( R = \{r_{s_1}, r_{s_2}, ..., r_{s_m}\} \): \( r_{s_i} \) represents the Relation Type between two skills in a SM, where the Relation Type is defined as the **APO**: \( s_i \) is **A Part Of** \( s_j \), or the **D**: \( s_i \) is **Dependence on** \( s_k \).

The structure of the SM for scientific inquiry is the same as the CM, except for cross-link relation definitions, Dependence Relations (D), which represent cause-and-effect relations between two skills. For example, Figure 4 illustrates an example of a partial SM for the scientific process, where the skill, Setting Variables, depends on the skill, Making Hypothesis.

![Figure 4: Example of a Partial Scientific Process Skill Map for the Scientific Inquiry Experiment](image)

Definitions of the Evaluation Knowledge

Definitions of the Key Operation Action Patterns:
During the Web-based scientific inquiry experiment, students will be asked to operate the Web-based operation experiment tool, which emulates the actual experiment operation, and their behavior will be collected and regarded as Operational Data of the scientific inquiry assessment portfolio. However, an important problem is how to automatically assess and evaluate operational data of students. Therefore, in the OPASS, the Key Operation Action Patterns (KOAP) has been proposed to evaluate the accuracy of students’ operational data. The KOAP defines key operational actions and sequences, which will influence the operational accuracy of the Web-based operation experiment tool. Accordingly, the teacher can define the necessary KOAP to observe and evaluate students’ operational data. The definitions related to the Experiment Operations (EO) and KOAP in terms of the Web-based operation experiment are defined as follows:

Definitions of the EO:

\[ \text{EO} = \{a_1, a_2, \ldots, a_n\} \]
denotes all actions that a student can operate in terms of a Web-based operation experiment tool in the scientific inquiry assessment experiment.

Definitions of the KOAP:

\[ \text{KOAP} = (KA, AC, AS, OC) \]
where:

- \( KA = \{a_i, a_{i+1}, \ldots, a_m \mid 0 \leq \text{amount of } KA \leq \text{EO}\} \) denotes the Key Action (KA), each action \( a_i \) of which plays an important action of all operational actions in EO, whose accuracy will influence the accuracy of the whole EO.
- \( AC = (a_i, a_{i+1}, a_{i+2}, \ldots) \) denotes the Action Continuity (AC), which is an action sequence with continuous actions.
- \( AS = (a_i, a_{i+j}, \ldots, a_{i+k} \mid i < j < k) \) denotes the Action Sequence (AS), which is an action sequence, but its continuity is not necessary.
- \( OC = (a_i, a_{i+1}, a_{i+2}, \ldots) \) denotes the Object Continuity (OC), which is a continuous action sequence for a targeted object.

Therefore, according to the definition of the KOAP, the accuracy of a student’s operational portfolio of a Web-based operation experiment tool can thus be automatically assessed, analyzed, and diagnosed. Table 1 illustrates examples of the KOAP with descriptions.

<table>
<thead>
<tr>
<th>Type</th>
<th>Illustration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key Action (KA)</strong></td>
<td><img src="description" alt="Illustration" /></td>
<td>[Filling] the [Red Water] in a [cup without scale] into the [Beaker with Scale] is a Key Action (KA).</td>
</tr>
<tr>
<td><strong>Action Continuity (AC)</strong></td>
<td><img src="description" alt="Illustration" /></td>
<td>In order to sniff out the fire correctly, [Action 1] must be followed by [Action 2] and it’s not allowable to operate other actions between them.</td>
</tr>
<tr>
<td><strong>Action Sequence (AS)</strong></td>
<td><img src="description" alt="Illustration" /></td>
<td>AS=(a_1, a_2, a_3, a_6) is a correct operational action sequence to finish the operation experiment, where [Action 2] must be done before [Action 5], but other actions can be operated between Action 2 and Action 5.</td>
</tr>
<tr>
<td><strong>Object Continuity (OC)</strong></td>
<td><img src="description" alt="Illustration" /></td>
<td>For the targeted object, Celery, it must be [Cut] only after [Dip into water]. It will be regarded as the incorrect operation if there are other actions between them.</td>
</tr>
</tbody>
</table>

Definitions of the Assessment Rules (AR):

In the OPASS, the rule-based inference approach has been applied to infer the accuracy of the assessment experiment according to a student’s assessment portfolio. Therefore, the teacher can define assessment rules in advance to evaluate the accuracy of a student’s answer and to identify learning problems related to subject
concepts, cause and effect operations, and skills of scientific inquiry. The assessment rule can be defined by the following definition.

**Definitions of the AR:**

\[ AR = \{A_1, A_2, \ldots, A_n\} \], where:

- \( A_i = \text{If } (\text{Condition Setting}) \text{ Then } (\text{Assessment Function}) \): each \( A_i \) of AR can be represented by the IF-THEN rule format, where:
  - **Condition Setting** = \( \{C_{s1}, C_{s2}, \ldots, C_{sm}\} \): each \( C_{si} \) of the Condition Setting can be used to evaluate the accuracy of the student’s answer in terms of the assessment portfolio consisting of planning data and operational data defined in Section: Definitions of Assessment Portfolio. If the result of the **Condition Setting** is true, the **Assessment Function** will be triggered to evaluate the student’s assessment portfolio.

In the OPASS, the Predicate Function (Giarratano & Riley, 2004) has been applied to be the function used in the AR. A predicate function is defined to be any function that returns TRUE or FALSE. Therefore, any value other than FALSE is considered as TRUE. The predicate function always returns a Boolean value. The **Assessment Function** used in the AR is defined as follows.

**Definitions of the Assessment Function in AR:**

- **WrongStep(Step, Problem):** checks the experiment Step, of the assessment procedure, which was executed correctly or not during the Web-based scientific inquiry experiment, where:
  - **Step**: the name of an experiment step in the scientific inquiry assessment experiment.
  - **Problem**: denotes a checking predicate function, which can check whether a student made this kind of problem at an executed experiment **Step**. Therefore, each **Problem** has its corresponding checking predicate function definition, which can be extended and defined by the teacher according to requirements of the assessment, such as:
    - **ObjectContinuity_Error**(obj), **ActionSequence**, **WrongPattern**: checks the accuracy of the continuity of the object (obj) defined in the KOAP according to the comparison between the correct Object Continuity (OC) (ActionSequence) and the student-made action pattern, which will be regarded as **WrongPattern**, if it is not the correct experimental operation.
    - **IndependentVariable_Error**(obj), **IF-Statement**, **Then-Statement**: checks the accuracy of the independent variable of the object (obj) according to the hypothesis setting (IF-Statement and Then-Statement), defined in Section: Definitions of Assessment Portfolio, that the student made.

**Example 1:**

If a student dipped a stalk of celery into water and then used a knife to cut its root during the virtual operation experiment, the accuracy of this experimental operation the student made can thus be checked by defined Assessment Functions, **WrongStep** "Action Operation", **ObjectContinuity_Error**([celery], [dip in water] [cut root] [put into tank] [waiting], [dip in water] [cut root]). Therefore, students’ operational actions, i.e., [dip in water] [cut root], are not correct because the correct object continuity definition (OC) of Key Operation Action Patterns (KOAP) was defined as [dip in water] [cut root] [put into tank] [waiting]. Moreover, the accuracy of the hypothesis setting can also be checked by the **WrongStep** "Operational Experiment", **IndependentVariable_Error**([celery], [cross section area of celery stem], [the decreasing quantity of the red water]).

**Condition Setting Function in AR:**

In addition to the assessment function, the condition setting of the AR can also use the predicate function to check the condition of a rule. Therefore, in the OPASS, the **Condition Setting** = \( \{C_{s1}, C_{s2}, \ldots, C_{sm}\} \), where, for instance, the \( C_{si} = \text{NotMatch(ObjectContinuity}(\text{targeted object, correct OC definition}) \): evaluates the accuracy between the correct OC definition and the student’s operational actions in terms of the targeted object, or \( C_{si} = \text{TargetObject(obj)} \& \text{IndependentVariable(X)} \& \text{CorrectIndependentVariable(Y)} \& (X \neq Y) \): evaluates the accuracy between the correct independent variable (Y) and the actual one that the student set (X) in terms of the targeted object (obj) and the condition will be true if the (X \neq Y) is true.

**Example 2:**

Assume there are \( A_1 = \text{If } (\text{NotMatch(ObjectContinuity}(\text{[celery]}), \{\text{[dip in water]}, \text{[cut root]}, \text{[put into tank] [waiting]}\})) \) **Then WrongStep** "Action Operation", **ObjectContinuity_Error**([celery], \{[dip in water], [cut root], [put into tank], [waiting]\}, \{[dip in water], [cut root]\}), and \( A_2 = \text{If } (\text{TargetObject([celery])} \& \text{IndependentVariable([length of stem])} \& \text{CorrectIndependentVariable([amount of leaves])} \& ((\text{length of stem}) \neq (\text{amount of leaves}))) \) **Then WrongStep** "Operational Experiment", **IndependentVariable_Error**([celery],
Definitions of the Assessment Portfolio

As seen in Figure 1, the assessment portfolio of scientific inquiry consists of planning data and operational data. Before the assessment process, the log of the Web-based experiment system must be transformed into the defined format in the OPASS. Logs of planning data, as shown in Table 2, are the set of attribute-value pairs. For example, in an experiment of biology transpiration, students defined a hypothesis: If the [celery’s] [leaves] are [more], the [decreasing quantity] of the [red water] is [more]. Then, logs recorded six attributes, including objects, attributes, and their changes in the condition and effect parts of the hypothesis.

Table 2: Example Logs of Planning Data

<table>
<thead>
<tr>
<th>Attribute Value</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothesis-IF-Object Celery</td>
<td>Hypothesis-THEN-Object Red water</td>
</tr>
<tr>
<td>Hypothesis-IF-Attribute Leaves</td>
<td>Hypothesis-THEN-Attribute Decreasing quantity</td>
</tr>
<tr>
<td>Hypothesis-IF-Value More</td>
<td>Hypothesis-THEN-Value More</td>
</tr>
</tbody>
</table>

Logs of operational data, as shown in Table 3, were a sequence of operations, which consists of an action name, a used object, an object of target, and a set of environmental attribute-value pairs. For example, the action sequence in Table 3 described that a student [fill] a [beaker with scale] with [red water]. Then, the student [dip] a [head of celery] into a [tank] and use a [knife] to [cut] the [stem of the celery]. Afterward, this student [put] the [celery] into the [beaker with scale] and [waited].

Table 3: Example Logs of Operational Data

<table>
<thead>
<tr>
<th>Action</th>
<th>Used Object</th>
<th>Target Object</th>
<th>Environmental Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill</td>
<td>Red water</td>
<td>Beaker with scale</td>
<td>Temperature: 25°C, Light: Yes, Humidity: 60%</td>
</tr>
<tr>
<td>Dip</td>
<td>Celery</td>
<td>Tank</td>
<td>Temperature: 25°C, Light: Yes, Humidity: 60%</td>
</tr>
<tr>
<td>Cut</td>
<td>Knife</td>
<td>Celery</td>
<td>Temperature: 25°C, Light: Yes, Humidity: 60%</td>
</tr>
<tr>
<td>Put</td>
<td>Celery</td>
<td>Beaker with scale</td>
<td>Temperature: 25°C, Light: Yes, Humidity: 60%</td>
</tr>
<tr>
<td>Wait</td>
<td></td>
<td></td>
<td>Temperature: 25°C, Light: Yes, Humidity: 60%</td>
</tr>
</tbody>
</table>

Online Assessment Portfolio Diagnosis Process Phase

By means the teacher-defined assessment knowledge related to the scientific inquiry experiment described in the previous section, the student’s assessment portfolio can thus be automatically evaluated and diagnosed by the Online Assessment Portfolio Diagnosis Process (OAPDP) in phase 2 of the OPASS. The details will be described in this section.

Procedure of the Online Assessment Portfolio Diagnosis Process

Figure 5 shows the flowchart of the OAPDP, which consists of three modules: (1) Evaluation Process; (2) Diagnosis Process; and (3) Diagnostic Report Generation. In the Evaluation Process, the OAPDP uses the teacher-defined Assessment Rule (AR) to evaluate the accuracy of the students’ scientific inquiry assessment portfolio and then finds the Wrong Experiment Step from the assessment result according to the inference results of the Rule Inference Process. Afterwards, in the Diagnosis Process, the OAPDP first diagnoses the mis-concept/skill with the corresponding reason for each wrong experiment step by means of the Diagnosis Rule (DR) based on the relation model of assessment knowledge as seen in Figure 2. The OAPDP further analyzes the Remedial Path according to relational definitions of the experiment knowledge, i.e., the prerequisite (PR) in the CM and the Dependence (D) in the SM of scientific inquiry. Consequently, the Major mis-concept/skill with the corresponding wrong experiment step can be discovered. Finally, the Diagnostic Report Generation module is able to generate the personalized scientific inquiry diagnostic report consisting of descriptions, corresponding reasons, and related remedial suggestions to correct learning problems based on the defined Description Format.
FIGURE 5: Flowchart of the OAPDP

Diagnosis Process in the OAPDP
As mentioned above, the Diagnosis Process module in the OAPDP uses the Diagnosis Rule (DR) based on the relation model of assessment knowledge to diagnose the mis-concept/skill with the corresponding reason for each wrong experiment step. In the OPASS, the DR has thus been proposed and defined as follows.

Definitions of the DR:

\[ \text{DR} = \{ \text{Dr}_1, \text{Dr}_2, \ldots, \text{Dr}_n \} \]

where:
- \( \text{Dr}_i \): If (Condition Setting) Then (Diagnostic Function); each Dr of the DR can be represented by the IF-THEN rule format, where three types of DRs are defined as follows:

1. **DRs of the Mis-Concept, Mis-Skill, and Reason**:

   - If (WrongStep($S$, $P$) & StepConceptRelation(WrongStep($S$, $P$), $C_{Concept}$)) Then MisConcept($C_{Concept}$): diagnoses the mis-concept ($C_{Concept}$) according to the relationship between the wrong experiment step (WrongStep()) and the associated concept by the function StepConceptRelation(). The $S$ and $P$ denote the Step and the Problem of Assessment Function, WrongStep(), in AR.
   - If (WrongStep($S$, $P$) & StepSkillRelation (WrongStep($S$, $P$), $S_{Skill}$)) Then MisSkill($S_{Skill}$): diagnoses the mis-skill according to the relationship between the wrong experiment step and associated skill of scientific inquiry by the function StepSkillRelation().
   - If (WrongStep($S$, $P$) & StepReasonRelation (WrongStep($S$, $P$), $S_{Type}$, $S_{Desc}$)) Then Reason($S_{Type}$, $S_{Desc}$): diagnoses the corresponding reason of occurred mis-concept or mis-skill according to the relationship between the wrong experiment step and associated reason, where $S_{Type}$ is “Concept” or “Skill,” each of which has a corresponding description ($S_{Desc}$) to explain the reason for a problem that a student made for the wrong experiment step.

2. **DRs of the Major Wrong Step of Assessment Experiment**:

   - If (MajorMisSkill($S_{Skill}$) & WrongStep($S$, $P$) & StepSkillRelation (WrongStep($S$, $P$), $S_{Skill}$)) Then MajorWrongStep($S$, $P$): diagnoses the major wrong experiment steps of a student according to the relationship between the wrong experiment and the major mis-skill.

3. **DRs of the Remedial Concept and Skill of Mis-Concept and Mis-Skill**:

   - If (MajorMisConcept($S_{Cx}$) & Prerequisite($S_{Cy}$, $S_{Cx}$)) Then PRCconcept($S_{Cy}$): diagnoses the remedial concept of the student’s mis-concept according to the prerequisite concept relationship (Prerequisite()) of the major mis-concept.
   - If (MajorMisskill($S_{Sx}$) & Prerequisite($S_{Sy}$, $S_{Sx}$)) Then PRskill($S_{Sy}$): diagnoses the remedial skill of the student’s mis-skill according to the prerequisite skill relationship (Prerequisite()) of the major mis-skill.

Table 4 lists examples of the DR Definition and Table 5 also presents examples of the Assessment Function Definition, WrongStep($S$, $P$), associated with the Problem Description, the Reason, and the Suggestion
Description. The learning problems related to the concepts, cause and effect operations, and skills of scientific inquiry can thus be analyzed and diagnosed by means of the proposed DR.

Table 4: Example of Three Types in the DR Definition

<table>
<thead>
<tr>
<th>Type</th>
<th>IF (Condition Setting)</th>
<th>THEN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Symbol Definitions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS1 = &quot;Operational Experiment&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS2 = &quot;Action Operation&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP1 = IndependentVariable_Error([celery], [cross section area of celery stem], [the decreasing quantity of the red water])</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP2 = ObjectContinuity_Error([celery], {[dip in water], [cut root], [put into tank], [waiting]}, {[dip in water], [cut root]})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr1: WrongStep($S1, $P1) &amp; StepConceptRelation( WrongStep($S1, $P1), , &quot;Transpiration&quot;)</td>
<td>MisConcept(&quot;Transpiration&quot;)</td>
<td></td>
</tr>
<tr>
<td>Dr2: WrongStep($S2, $P2) &amp; StepConceptRelation( WrongStep($S2, $P2), , &quot;Transpiration&quot;)</td>
<td>MisSkill(&quot;Experimental Operation&quot;)</td>
<td></td>
</tr>
<tr>
<td>Dr3: WrongStep($S2, $P2) &amp; StepSkillRelation( WrongStep($S2, $P2)), &quot;Transpiration&quot;)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5: Example of WrongStep($S, $P) Definition Associated with Problem Description, Reason, and Suggestion Description in the OPASS

<table>
<thead>
<tr>
<th>DR</th>
<th>Step ($S)</th>
<th>Problem ($P)</th>
<th>Problem Description (A), Reason (B), Suggestion Description (C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr1</td>
<td>Making Hypothesis</td>
<td>Hypothesis_Error( scene, IF-Statement, Then-Statement)</td>
<td>A Because the solution that you made in the [scene] is that &quot;IF [IF-Statement] THEN [Then-Statement]&quot;, it can not solve the problem of the experiment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C Please carefully read the &quot;Problem Description&quot; of [scene] again and try to use another approach to solve it.</td>
</tr>
<tr>
<td>Dr2</td>
<td>Operational Experiment</td>
<td>VariableOperation_Error (Variable)</td>
<td>A The [Variable] you operate is not the same variable you set in the Setting Variable Step of the experiment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B Reason(&quot;Skill&quot;,&quot;the variable that you set in the Setting Variable Step of the experiment can not be operated in this experiment&quot;)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C You must operate the same variable in the Setting Variable Step and the Operational Experiment Step both.</td>
</tr>
<tr>
<td>Dr3</td>
<td>Action Operation</td>
<td>ObjectContinuity_Error (Obj, ActionSequence, WrongPattern)</td>
<td>A Because the [Obj] must be operated by [ActionSequence], we guess that your operation order [WrongPattern] is wrong.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B Reason(&quot;Concept&quot;, &quot;you may not thoroughly understand the [MisConcept]&quot;)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C We suggest that you should learn the [MajorMisConcept] and [MisConcept] in advance.</td>
</tr>
</tbody>
</table>
Example 3:
The left-hand side of Figure 5 illustrates the rule inferring process during the OAPDP process by employing the rule-based inference approach. To follow the descriptions in Examples 1 and 2, if the $A_1$ in AR come to be true, a Wrong Experiment Step, "Action Operation," can be found from the assessment portfolio of scientific inquiry in the Evaluation Process. Therefore, in the Diagnosis Process, after the Mis-concept and Mis-Skill Diagnosis, the mis-concept, "Transpiration," and the mis-skill, "Experimental Operation," at this "Action Operation" step can be inferred by using the Dr$_2$ of Type 1 and the Dr$_3$ of Type 1 in DR in Table 4, respectively. Afterwards, in the Remedial Path Diagnosis, the major mis-concept, "Water Transportation," can be found through the Dr$_1$ of Type 3, and according to the inferred mis-concept and the definition of the concept map in Figure 3. Finally, by using the aforementioned results, the Dr$_1$ in Table 5 was triggered to reason and diagnose the learning problems with Problem Description, Reason, and Suggestion Description for this wrong experiment step, "Action Operation." Consequently, the personalized diagnostic results can be offered to the student as follows: You had the wrong experiment step at [Action Operation Step], (A) because the [Obj="celery"] must be operated by [ActionSequence="[dip in water], [cut root], [put into tank], [waiting]"], we guess that your operation order [WrongPattern="[dip in water], [cut root]"is wrong. (B) The Reason is that "you may not thoroughly understand the [MisConcept="Transpiration"] ". (C) We suggest that you should learn the [MajorMisConcept="Water Transportation"] and ["MisConcept="Transpiration"] in advance. Consequently, the various learning problems, concerning conceptual knowledge, cause and effect operations, and skills of scientific inquiry, with corresponding reasons and remedial suggestions can be automatically analyzed and diagnosed by the Diagnosis Process in the OAPDP. These diagnostic results will be further organized and synthesized into a readable and understandable report in the Diagnostic Report Generation in the OAPDP.

Diagnostic Report Generation
After the Evaluation and Diagnosis process modules have been processed, the students' learning problems in relation to the concepts, cause and effect operations, and skills of the scientific inquiry experiment can be diagnosed, and corresponding reasons and descriptions can also be acquired. The personalized diagnostic report can thus be generated by running the Diagnostic Report Generation in the OAPDP. The proposed Diagnostic Report Generation Algorithm (DRGalgo) is described in Algorithm 1, and Figure 6 shows an example of the personalized diagnostic report generated by the DRGalgo.

```
Algorithm 1: Diagnostic Report Generation Algorithm (DRGalgo)

Symbol Definition:
- $WrongStep$: the detected wrong experiment step of SI experiment for the student.
- $MisConcept$: the detected mis-concept of the student.
- $MisSkill$: the detected mis-skill of the student.
- $MajorWrongStep$: the detected major wrong step of SI experiment for the student.
- $MajorMisConcept$: the detected major mis-concept of the student.
- $MajorMisSkill$: the detected major mis-skill of the student.
- $PRConcept$: the prerequisite concept of a concept.
- $S$: output the value of variable

Input: All detected wrong experiment steps of SI assessment experiment
Output: Personalized Diagnostic Report

Step 1: Generate the detailed description for each Wrong Step ($WrongStep$)of Assessment Experiment,
1.1: output the statement: "[Problem]: you made wrong action at [WrongStep] Step."
1.2: output the statement: "[Corresponding Skill]: [MisSkill]."
1.3: output the statement: "[Phenomenon]: [the Problem Description of WrongStep])"
1.4: If Reason.Type = "Concept"
   Then output the statement: "[Possible Reason]: you may not thoroughly understand the [MisConcept]."
   Else If Reason.Type = "Skill"
   Then output the statement: "[Possible Reason]: because [the Reason Description of WrongStep] for the [MisSkill]"
1.5: output the statement: "[Suggestion]: [the Suggestion Description of WrongStep])"

Step 2: Generate the overall diagnostic description for student’s assessment result
2.1: If [conclusion is wrong]
   Then
   (1) output the statement: "[Problem]: your conclusion is wrong. The possible reason may be the [the Problem Description of the MajorWrongStep])."
```
Implementation and Experiment
Prototypical System of the OPASS

In order to evaluate the effectiveness of the OPASS, the prototypical system has been developed, as shown in Fig 7. The OPASS system consists of three databases: (1) Assessment Knowledge Base; (2) Diagnosis Rule Base; and (3) Assessment Portfolio Database. The assessment knowledge can be defined by teachers to meet the requirements of scientific inquiry assessments based on the proposed Assessment Knowledge (AK) definition. The OPASS can be integrated with the Web-based scientific inquiry experiment system based on the proposed connection protocol. Therefore, students can use the browser to take the scientific inquiry assessment and their operational behavior will be recorded into the assessment portfolio database. After students finish the assessment, the OAPDP will automatically analyze the assessment portfolio using the rule inference process according to assessment knowledge and then automatically generate personalized diagnostic reports to students according to diagnostic rules.
As seen in Figure 8, six assessment activities executed on the Web-based scientific inquiry experiment system have also been developed for the Physics (Figure 8b) and Biology (Figure 8c) experiments, respectively. In Figure 8a, each assessment was developed based on the assessment procedure consisting of six steps, where the operation experiment in step 3 offers a Web-based interactive, operational experiment tool to allow students to operate it and observe responses and reactions.

**EXPERIMENTAL RESULTS**

**Experiment Plan and Execution:**

In order to evaluate the performance of the prototypical OPASS system, several experiments were conducted. Two classes, from different schools in Taiwan, participated in the assessment experiments. Thirty first-grade students of high school, in the urban district, and ten third-grade students of junior high school, in the remote district, participated in the assessment experiments of scientific inquiry in Biology and Physics, respectively. First, teachers explained the purpose of the experiment and taught students how to use the Web-based scientific inquiry experiment system (OPASS). Students could practice and familiarize themselves with the system by participating in the testing experiment (Figure 9a). Following the practice test, the students took the formal assessment experiments (Figure 9b) to understand their learning problems by means of personalized diagnostic reports (Figure 9c). Finally, a questionnaire of a five-level Likert Scale, as seen in Table 6, was designed and provided to students to evaluate their degrees of satisfaction concerning the OPASS system.
Table 6: Questionnaire of Students’ Degrees of Satisfaction of the OPASS System (Five-Level Likert Scale from 1 (Strongly Disagree) to 5 (Strongly Agree))

| Q1: | It would be helpful to provide personalized analysis and learning suggestions concerning the operation and examination after the assessment experiment. |
| Q2: | In Part A of the diagnosis report, the bar charts of skills, concepts, and overall scores can assist you in understanding your assessment outcome. |
| Q3: | In Part B of the diagnosis report, the descriptions consisting of the wrong plans, wrong operations, reasons, and possible remedial suggestions can assist you in understanding the problems during the experiment. |
| Q4: | In Part C of the diagnosis reports, the descriptions concerning the overall diagnosis and suggestions can improve your learning. |
| Q5: | This diagnosis report is useful and can improve your learning efficacy. |

Figure 9: (a) Students Practicing the OPASS, (b) Taking the Examination, and (c) Reading the Diagnostic Report Regarding the Scientific Inquiry Experiment in the Physics Domain

RESULT ANALYSIS

Analysis of Student’s Scores in the OPASS System

- Correlations of OPASS Scores with Prior Knowledge Measures

Examining the correlations of the OPASS scores with each measure of prior knowledge can help clarify meaning. For example, students with more prior knowledge tended to perform better on each score of the OPASS than students with lower levels of prior knowledge. The prior knowledge measures were intended to give an indication of the degree of student familiarity with the science and related concepts being assessed in the scientific inquiry experiments of the OPASS system (Bennett et al., 2007, 2010). In this paper, the prior knowledge measures consist of two kinds of knowledge: (1) Science Knowledge; and (2) Scientific Inquiry. The prior science knowledge measure was designed to be related to the Physics and Biology domain. Therefore, the grade of a student of Physics and Biology at school was adopted as the prior science knowledge measure.

The prior scientific inquiry knowledge measure was intended to concern skills of scientific inquiry. In order to assess prior scientific inquiry knowledge of participant students, a comprehensive Test of Integrated Science Process Skill (TIPS) was developed by Dillashaw and Okey (1980). This test included integrated science process skills (e.g., stating hypotheses, controlling variables, designing experiments, operational definition, graphing and interpreting data) and was adopted as a reference to design a Chinese version. The TIPS had a high reliability (0.89) and was non-curriculum-specific for the middle and secondary schools. Afterwards, Burn, Okey, and Wise. (1985) developed the TIPS II based on the original TIPS.

By means of the data collected from the experiments of the OPASS system, Table 7 lists the summary statistics of the Prior Science Knowledge and the OPASS Measures for the 30 first-grade high school students (Grade 10) in the Physics domain (effective sample size (N) = 24). Table 8 presents the correlations of the “Total Score” of the OPASS, consisting of “Scientific Inquiry” and “Science Knowledge”, with the two prior knowledge measures, “Science Knowledge” and “Scientific Inquiry knowledge.”
Table 7: Summary Statistics for Prior Knowledge and OPASS Measures – Grade 10, Physics domain

<table>
<thead>
<tr>
<th>Measures</th>
<th>Prior Science Knowledge</th>
<th>OPASS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Science Knowledge: Grade in Physics</td>
<td>Total Score</td>
</tr>
<tr>
<td>Number of Students (N)</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Mean Score</td>
<td>71.88</td>
<td>72.64</td>
</tr>
<tr>
<td>Standard Deviation (SD)</td>
<td>9.205</td>
<td>7.982</td>
</tr>
</tbody>
</table>

Table 8: Correlations of OPASS Scores with Prior Knowledge Measures in TIPS – Grade 10, Physics Domain

<table>
<thead>
<tr>
<th>OPASS Score</th>
<th>Prior Science Knowledge: Grade in Physics</th>
<th>Prior Scientific Inquiry Knowledge: Total Score of TIPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>-.263</td>
<td>.431*</td>
</tr>
<tr>
<td>Scientific Inquiry</td>
<td>-.156</td>
<td>.492*</td>
</tr>
<tr>
<td>Science Knowledge</td>
<td>-.290</td>
<td>.313</td>
</tr>
</tbody>
</table>

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

According to the correlations in Table 8, the “Total” score of OPASS did not correlate with the two prior knowledge measures: “Science Knowledge: Grade in Physics” and “Prior Scientific Inquiry Knowledge: Total Score of TIPS.” In addition, the “Prior Science Knowledge” did not correlate with the “Prior Scientific Inquiry Knowledge.” This indicates that the mastery levels of students’ grades in Physics may not influence the performance of OPASS and TIPS.

Besides, the “Total” score of TIPS has the significant positive correlations with the “Total” score (0.431, p<.05) and “Scientific Inquiry” (0.492, p<.05) of OPASS, respectively. This means that students with more prior scientific inquiry knowledge tend to perform better on “Total” and “Scientific Inquiry” scores of the OPASS. Furthermore, the “Scientific Inquiry” of OPASS has a significant positive correlation (0.584, p<.01) with the “Science Knowledge” of OPASS. The reason for this outcome is that the OPASS system integrated the scientific inquiry skills and science knowledge together with each step and action of the Web-based assessment procedure.

According to the results of Table 8, the “Total” score of the OPASS has a significant correlation with the TIPS score. In this paper, the “Scientific Inquiry” score of OPASS consists of five scales: (1) Making Hypothesis; (2) Setting Variables; (3) Experimenting; (4) Graphing; and (5) Concluding. For estimating the correlations, the TIPS scales were mapped to these five OPASS scales. Therefore, the correlations of each sub-score of OPASS with TIPS are shown in Table 9 to investigate the reliability and validity of the OPASS system.

Table 9: Correlations of OPASS Scores with Prior Knowledge Measures in TIPS – Grade 10, Physics Domain

<table>
<thead>
<tr>
<th>OPASS Score</th>
<th>TIPS Score</th>
<th>Making Hypothesis</th>
<th>Setting Variables</th>
<th>Experimenting</th>
<th>Graphing</th>
<th>Concluding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>.031</td>
<td>.506*</td>
<td>.271</td>
<td>.235</td>
<td>.203</td>
<td></td>
</tr>
<tr>
<td>Scientific Inquiry</td>
<td>.059</td>
<td>.352</td>
<td>.237</td>
<td>.149</td>
<td>.210</td>
<td></td>
</tr>
<tr>
<td>Science Knowledge</td>
<td>.005</td>
<td>.509*</td>
<td>.240</td>
<td>.245</td>
<td>.158</td>
<td></td>
</tr>
<tr>
<td>(1) Making Hypothesis</td>
<td>.a</td>
<td>.a</td>
<td>.a</td>
<td>.a</td>
<td>.a</td>
<td></td>
</tr>
<tr>
<td>(2) Setting Variables</td>
<td>.025</td>
<td>.593**</td>
<td>.147</td>
<td>-.062</td>
<td>.166</td>
<td></td>
</tr>
<tr>
<td>(3) Experimenting</td>
<td>-.145</td>
<td>.254</td>
<td>.120</td>
<td>-.073</td>
<td>-.054</td>
<td></td>
</tr>
<tr>
<td>(4) Graphing</td>
<td>.199</td>
<td>.147</td>
<td>.303</td>
<td>.646**</td>
<td>.351</td>
<td></td>
</tr>
<tr>
<td>(5) Concluding</td>
<td>-.038</td>
<td>-.151</td>
<td>-.074</td>
<td>-.320</td>
<td>-.094</td>
<td></td>
</tr>
</tbody>
</table>

a. Cannot be computed because at least one of the variables is constant.

As Table 9 shows, the correlation values of “Making Hypothesis” (OPASS) with TIPS cannot be computed because all students correctly performed this step in OPASS. The “Concluding” (OPASS) also did not correlate with the one of TIPS because 19 out of 24 students were correct. The reason for this is that students learned concepts and skills related to “Making Hypothesis” and “Concluding” in the practice section, and such learning effects subsequently became prior knowledge when the students took the online assessment of scientific inquiry in the examination section, as depicted in Figure 9.

The “Experimenting” portion (OPASS) has no significant positive correlation with the one of TIPS. That is
because students were required to interact and operate the Web-based operation experiments at the “Experimenting” step in the OPASS system, which can be regarded as a "hands-on" assessment. The operational data of students, as shown in Table 3, were recorded and collected in the assessment portfolio and assessed according to the teacher-defined assessment knowledge definition, e.g., Key Operation Action Pattern (KOAP). On the contrary, the TIPS is a paper-and-pencil test and is a suitable approach to measure students' knowledge of scientific concepts and inquiry (e.g., Substantive Knowledge), but it is not easy to assess and evaluate learning problems and performance of higher-order capabilities related to scientific inquiry.

Furthermore, the “Setting Variables” and “Graphing” in the OPASS system have significant positive correlations (0.593 and 0.646, p < 0.01) with the ones of TIPS, respectively. Those correlations describe that students with more prior knowledge in terms of “Setting Variables” and “Graphing” in TIPS tend to perform better on corresponding scales in the OPASS system than students with lower levels. Consequently, the significant correlations between the OPASS and the TIPS can show that the OPASS system is able to perform a reliable and valid assessment of scientific inquiry.

In addition to the evaluation for grade 9 students in the Biology domain at the urban district, the prototypical OPASS system was evaluated by 10 grade 9 students who reside in the remote district, as listed in Table 10 and 11, respectively. The results show that the performance of the OPASS has no significant correlations with the “Prior Knowledge” of students in terms of “Average of Subjects” and “Grade in Biology,” which is the same as the experiment results in Physics.

Table 10: Summary Statistics for Prior Knowledge and OPASS Measures – Grade 9, Biology Domain

<table>
<thead>
<tr>
<th>Measures</th>
<th>Prior Knowledge</th>
<th>OPASS</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Knowledge:</td>
<td></td>
<td>Scientific</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average of</td>
<td></td>
<td>Inquiry</td>
<td>Science</td>
<td>Science</td>
</tr>
<tr>
<td>Number of</td>
<td>Subjects</td>
<td>10</td>
<td>Total Score</td>
<td>Knowledge</td>
<td>Knowledge</td>
</tr>
<tr>
<td>Students (N)</td>
<td></td>
<td></td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean Score</td>
<td>75.27</td>
<td>78.83</td>
<td>56.83</td>
<td>62.00</td>
<td>51.67</td>
</tr>
</tbody>
</table>

Table 11: Correlations of OPASS Scores with Prior Knowledge Measures – Grade 9, Biology Domain

<table>
<thead>
<tr>
<th>OPASS Score</th>
<th>Prior Knowledge: Average of Subjects</th>
<th>.065</th>
<th>.132</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scientific</td>
<td>-0.070</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge</td>
<td>.154</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Assessment Accuracies of the OPASS System through Domain Experts

In addition to the evaluation by the correlations between the OPASS system and a comprehensive TIPS test with high reliability and validity, the evaluations of domain experts are also important for evaluating the accuracy of diagnostic reports (Ting et al., 2008). Therefore, an evaluation tool was developed to allow the domain expert to review and evaluate the accuracies of the diagnostic results of each student by checking the assessment portfolios. Three teachers as domain experts were invited to evaluate all students’ experimental logs and score all statements in the diagnostic reports generated by the OPASS system. A statement’s score was from 0 to 1. Figure 10 shows the statistical results in terms of different parts of the diagnostic report for three tests shown in Figure 6. According to evaluation results, the accuracies of the diagnostic reports are very high and meet the professional opinions of the teachers. In addition, the teachers also agreed that automatic, generated diagnostic reports can significantly assist teachers in understanding the status of students’ inquiry abilities. This personalized diagnosis task is difficult for teachers to complete manually.
Analysis of Students’ Feedback

Figure 11 shows the statistical results of the questionnaire (Cronbach's Alpha = 0.825) concerning students’ satisfaction in terms of two classes (N=10 in Class 1 for Biology and N=24 in Class 1 for Physics), as shown in Table 6. The satisfaction degree is from 3.86 to 4.2 and the average is 4.17. This shows that most of students agreed that the diagnostic mechanism and the diagnostic report generated by the OPASS system are useful and can be expected to improve learning efficacy and assist in understanding the learning and operational problems in Web-based scientific inquiry experiments.

LIMITATION AND DISCUSSION

Limitation of the OPASS

We discussed the limitations of our proposed OPASS approach in terms of the following three aspects.

1. Capability of the Relation Model of Assessment Knowledge (AK)

   According to the definition, the Relation Model can represent diverse requirements of scientific inquiry assessment performed by the OPASS system. However, some requirements of definitions, such as KOAP and Assessment Rules (AR), may not be wholly considered in this paper. Therefore, the Relation Model definition needs to be extended according to new requirements of scientific inquiry experiments.

2. Capability of the Online Assessment Portfolio Diagnosis Process (OAPDP)

   The accuracy of diagnostic reports depends on the correct definitions of teacher-defined AK and Diagnosis Rules (DR). Therefore, the mechanism of OAPDP and DR needs to be modified and adjusted if the definition of AK has been extended to meet various requirements of scientific inquiry experiments.

3. Capability of the Usability of the OPASS

   The OPASS can automatically analyze students’ portfolios and generate personalized diagnostic reports concerning the learning problems with reasons and suggestions. However, it is still difficult and time-consuming to edit the teacher-defined AK without the support of the management tool; this will decrease the usability of the OPASS.

Discussion of the OPASS

According to evaluation results of the correlations of students’ OPASS scores with their prior knowledge, including Science Knowledge and Scientific Inquiry, the students’ master levels in terms of prior science knowledge in Physics and Biology subjects may not reflect similar performance in the OPASS and the TIPS scores because these testing mechanisms focus on the assessment of scientific inquiry abilities while the grade of...
subjects at school may not consider this an important aspect. On the contrary, the purposes of OPASS and TIPS aim to assess the abilities of scientific inquiry, so the “Total” score of the OPASS significantly correlates 0.431 (p<0.05) with the TIPS. Accordingly, this result proves that students with more prior scientific inquiry knowledge evaluated by the TIPS tend to perform better on the OPASS than students with lower levels. To investigate the correlations of sub-scores between the OPASS and the TIPS in terms of five scales: (1) Making Hypothesis; (2) Setting Variables; (3) Experimenting; (4) Graphing; and (5) Concluding, the reliability and validity of the OPASS can thus be evaluated. Results in Table 9 show that “Setting Variables” and “Graphing” of the OPASS have significant positive correlations (0.593 and 0.646, p < 0.01) with the ones of the TIPS, respectively. However, the “Making Hypothesis” and “Concluding” scales of the OPASS did not correlate with the ones of the TIPS due to the students’ prior knowledge attained through the practice section of the OPASS. This issue can be resolved by defining more various types of test items in these two steps of the OPASS.

Furthermore, the OPASS takes into account not only the science knowledge but also integrative abilities concerning scientific inquiry, so students were requested to operate the hands-on, Web-based operation experiments. Therefore, the learning problems concerning cause and effect operation behavior can thus be assessed by the OPASS, while the TIPS restricted to the confines of the paper-and-pencil test, cannot perform it well. This difference resulted in the “Experimenting” step of the OPASS did not obtain a significant positive correlation with the corresponding step of the TIPS. In addition, through the evaluation of three domain experts, the assessment accuracies of the diagnostic reports are very high (average is from 0.92 to 0.94) and meet the professional opinions of teachers. Therefore, the OPASS is valid and reliable for assessing the scientific inquiry abilities according to the analysis results in terms of the correlations and assessment accuracies.

In addition, during the OPASS experiments, teachers provided the following feedback:

**Feedback 1:** “This system can indeed attract students’ interests and improve their motivation to understand learning problems. For example, some students tried the assessment experiment many times to correct their mistakes and actively discuss with teachers after reading their diagnosis reports.”

**Feedback 2:** “This system can help both students and teachers with scientific inquiry learning and assessment, although it is still under development.”

According to the teachers’ aforementioned feedback, we can conclude that the OPASS is helpful and useful for both teachers and students in learning and assessing scientific inquiry capabilities.

Moreover, according to the survey of existing research described in the related work section, the methods employed as the criteria in this paper can be defined. These definitions can be based on what types of knowledge and capabilities (“substantive knowledge,” “procedural knowledge,” or “problem solving and integrated abilities”) are to be assessed to support what purposes (“general” or “scientific inquiry-based assessment”) by means of what the assessment items’ format (“selected response item,” “constructed response item,” “actual experimenting,” “virtual and Web-based experimenting tool”), and how to evaluate performance (“manually” or “automatically” assessing) to provide students with what results (“summary score” or “diagnostic report”). Furthermore, the extensibility of proposed systems are primary concerns. Table 13 shows the comparison of our approach with existing articles in relation to assessment and diagnosis of scientific inquiry in terms of the aforementioned criteria.

The differences between our proposed approach and the existing studies are:

1. We define the representation of AK, consisting of Experiment and Evaluation Knowledge, considering not only Substantive Knowledge, but also Procedural Knowledge, and Problem Solving and Integrative Abilities to efficiently describe the requirements of the assessment and diagnosis for the purpose of Scientific Inquiry-based Assessment.
2. We define the Relation Model to integrate the teacher-defined AK and DR, which can be efficiently processed by employing the rule-based inference approach to identify the students’ learning problems.
3. We proposed an online automatic diagnosis scheme to efficiently analyze the assessment portfolios and generate the personalized diagnostic reports concerning not only the summary score of the assessment, but also the learning problems, with reasons and suggestions, in relation to conceptual knowledge, cause and effect operations, and skills of scientific inquiry.
4. We define the connection portocol of the OPASS to efficiently integrate with virtual and Web-based experiment tools/systems to enhance the extensibility of the system.

In contrast to the OPASS, existing research separately or partially considered the knowledge (Hwang, 2003; Chu et al., 2010) and abilities of scientific inquiry (Ting et al., 2008) to provide students with performance results described by either the summary score (Bennett et al., 2007, 2010) and limited suggestions (Ting et al., 2008)
only, or diagnostic reports concerning learning problems (and associated reasons and suggestions) assessed by manually evaluating students’ portfolios (Hanauer et al., 2009).

<table>
<thead>
<tr>
<th>Table 13: Comparison with Existing Approaches (O: Yes, ×: NO, ∆: Partial)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Method</strong></td>
</tr>
<tr>
<td>Scientific Inquiry-based Assessment</td>
</tr>
<tr>
<td>Knowledge Types of assessment</td>
</tr>
<tr>
<td>Substantive Knowledge</td>
</tr>
<tr>
<td>Procedural Knowledge</td>
</tr>
<tr>
<td>Problem Solving &amp; Integrative Abilities</td>
</tr>
<tr>
<td>Formats of Assessment Items</td>
</tr>
<tr>
<td>Multiple choice questions (Selected Response Item)</td>
</tr>
<tr>
<td>Open-ended questions (Constructed Response Item)</td>
</tr>
<tr>
<td>Actual Experimenting</td>
</tr>
<tr>
<td>Virtual &amp; Web-based Experiment Tool</td>
</tr>
<tr>
<td>Performance Evaluation</td>
</tr>
<tr>
<td>Presented by (Summary) Score</td>
</tr>
<tr>
<td>Diagnostic Report about</td>
</tr>
<tr>
<td>Problem, Reason, Suggestion</td>
</tr>
<tr>
<td>Cause and Effect Operation</td>
</tr>
<tr>
<td>Automatic Assessment Approach for Portfolio</td>
</tr>
<tr>
<td>Extensibility</td>
</tr>
</tbody>
</table>

**CONCLUSION**

In order to provide students with personalized learning guidance concerning not only the conceptual knowledge, but also the high-order, integrative abilities of scientific inquiry, the OPASS system was proposed to automatically generate personalized diagnostic reports by evaluating assessment portfolios collected from the Web-based scientific inquiry experiment. The diagnostic reports described the students’ performance using not only the summary score of the assessment, but also learning problems with corresponding reasons and remedial suggestions. In the OPASS, students were requested to operate the hands-on, Web-based operation experiments. Therefore, learning problems concerning the cause and effect operation behavior can be assessed according to the teacher-defined assessment knowledge.

For the evaluation, experiments of the prototypical OPASS system have been conducted. The reliability and validity of the OPASS can be evaluated and proved due to significant correlations between the OPASS and a comprehensive Test of Integrated Science Process Skill (TIPS), and high accuracies evaluated by domain experts. Additionally, according to feedback from both students and teachers, the OPASS system can improve students’ motivation to understand learning problems, and it can help teachers to understand students’ learning status and provide more appropriate instruction.

In conclusion, the three main contributions of this paper include:

1. A proposal of the extensible Relation Model, which integrates teacher-defined assessment knowledge with diagnosis rule to represent relevant knowledge and abilities of scientific inquiry, processed by the rule-based inference approach.
2. A proposal of the Online Assessment Portfolio Diagnosis Process (OAPDP) to automatically generate personalized diagnostic reports concerning learning problems with reasons and suggestions.
3. A proposal of the OPASS’s connection protocol to efficiently integrate with Web-based experiment systems to enhance the extensibility.

In the near future, the online diagnosis scheme in the OPASS will be enhanced, the support of the diverse assessments will be enriched, and the satisfaction of both students and teachers need to be further improved. The knowledge sharing and managing mechanism will be focused to reduce the cost of constructing the assessment knowledge. Behavior mining techniques will be applied to discover various potential experimental behaviors to assist teachers in designing assessment rules and key operation action patterns.
REFERENCES


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OPINIONS OF STUDENTS IN PHYSICAL EDUCATION AND SPORTS TEACHING ON THE USE OF SOCIAL NETWORK SITES

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ABSTRACT
Because an important period of time of daily life has been spent on the Internet, the way people communicate has recently changed. One of the most important reasons for this change is social network sites (SNS). It can be seen that the most adhesive users of SNS in Turkey which have gained an increasing global quality are students. This descriptive study was made in order to determine the aims of 180 students who attend Sakarya University (SU) Physical Education and Sports Teaching Department (PESTD) in 2010 to use SNS, the duration they use SNS and their opinions on the credibility of SNS. Data were obtained through an interview and a questionnaire established by the researcher. They were evaluated by the program SPSS 15.0. In the statistical evaluation factor analysis, T-test, ANOVA and Chi-Square tests were implemented. At the end of the study, it was found that the participants use SNS mostly in order to learn what their friends are doing (66,7 %), to spend time (57,2 %), to be informed about sports organizations (55,6 %); and that they use the Internet to log in SNS (53,9 %) 1-2 hours (40,6 %) or less than 1 hour (24,4 %) a day. Moreover, it was found that SNS cause interference in their private lives (58,4 %); their negative effects are more than positive ones (46,2 %); and SNS are not safe (43,9 %). When results are evaluated generally, it can be said that the participants are conscious of SNS and the Internet.

INTRODUCTION
Over the past decade, the communication uses of the Internet have become a very important part of young people's lives (Gemmill & Peterson, 2006; Jones, 2002; Lenhart & Madden, 2007; Subrahmanyam & Greenfield, 2008). Recent reports find that the youth spend nearly 10 hours a day using some form of technology, with socially networked media playing a large role in their daily lives (Rideout, Foehr, & Roberts, 2010). Sites such as MySpace and Facebook have over 100 million users, many of whom are adolescents and emerging adults (Subrahmanyam, Reich, Waechter & Espinoza, 2008).

The communication forums of the Internet are many and varied and include applications such as instant messaging, email, and chat rooms as well as Internet sites such as blogs, SNS, photo and video sharing sites such as YouTube, and virtual reality environments such as Second Life. The mechanism of socialized Internet improves close interpersonal relationships and provides nonverbal communication media such as multimedia audio-visual objects, images, pictures, and other diverse media. By communicating and sharing with others through resourceful media, interpersonal interaction becomes closer (Huang, Yang, Huang & Hsiao, 2010).

Social Network Sites (SNS)
The social network is utilized to sustain existing offline relationships or support offline connections, as opposed to meeting new people. These relationships may be based on frail ties, but typically there is some common offline connection among individuals (Ellison, Steinfield, & Lampe, 2007). Boyd (2006) defines SNS as a category of Web sites with profiles, semi-persistent public commentary on the profile, and a traversable publicly articulated social network displayed in relationship to the profile.

SNS are “web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system” (Boyd & Ellison, 2007). Almost all SNS allow various levels of privacy controls, the most important of which is the level of “visibility.” In Facebook, the default visibility level is visibility to everyone in the network. There is no such walled area in Myspace. However, both in Facebook and in Myspace, one may also restrict the profile to “friends only,” meaning that only other profiles that are explicitly linked as a “friend” can access one’s profile. It is important to note that “friend” in a social network site is not synonymous with “friend” as it is generally understood, but there is some overlap between the concepts (Tüfekçi, 2008).
Uses of SNS for Teaching and Learning

Nowadays, many researches try to use the trend of Web 2.0 to push forward a new learning model, for example, applying blogs in learning and conducting knowledge sharing through blogs. Furthermore, due to the progress of wireless Internet and mobile devices, the mobile learning environment has gradually become stable and mature, for example, the mechanism of providing learning services in the mobile learning environment (Huang, Yang, Huang & Hsiao, 2010).

Boyd (2007) presented four important properties of mediated publics, which are persistence, searchability, replicability, and invisibility. Emergence of new online technologies expands the way people use online SNS, which may require these properties to be refined. As educators begin integrating online social networking within curriculum and instruction, it is important to consider how these properties influence the way the youth interact, socialize, and make personal and group decisions. Boyd included examples of how teachers may use and teach online social networking to teens.

In order to understand how to incorporate online social networking tools into the academic setting, one must understand how these tools are used to socialize, communicate, and interact online (Miller, 2009). SNS represent an opportunity for administrators and faculty members to reach out in a way that is more relevant to students than traditional email or classroom conversation. Traditional online course software also may receive little attention from students. But Facebook is where students live. It is not uncommon for students to log onto Facebook nearly every hour. In fact, some students have recognized that they spend too much time using Facebook, to the detriment of other aspects of their social life (Hoffman, 2008).

The technology itself does not improve learning, but social media might help students become more connected and engaged with their school communities. Online SNS widen a students’ access to resources and social support and may have beneficial effects on their development. Conversely, as student access to the world widens, they are inevitably exposed to potentially negative material and interactions (Ahn, 2010). Although the Internet technology has made it possible for people to collaborate effectively without staying physically together, they have led to the unintended consequence of increasing isolation among people with respect to their academic peers (Huang, Yang, Huang & Hsiao, 2010). Karpinski (2009) found that college Facebook users had lower GPAs than students who were not users of the site. The author also found that Facebook users were more likely to participate in extra-curricular activities and also come from science, technology, engineering, and math fields.

The simplest strategy to limit liability and to safeguard school districts is to ban access to these new digital tools. However, such policies neglect the potentially large benefits of using social media in the classroom. To alleviate this dilemma, educators and policymakers need a deeper understanding of social media and the youth. Several questions are critical in the area of youth learning with social technologies (Ahn, 2010):

• Which groups of youth are using particular social technologies?
• How do they use these technologies to communicate, develop relationships, socialize, and learn?
• What are the effects of these technologies on youth development?
• What are the effects of these technologies when applied in educational contexts such as the classroom?

Considering these facts, in this study, it is aimed to assess the usage of SNS and the Internet of the students at Sakarya University Physical Education and Sports Teaching (SUPESTD).

METHOD

In the research, descriptive/survey method was used to determine the situation. Theoretical framework of research was created following the literature review. Research data were collected using the survey and interview. The survey developed by the researcher was composed of four parts. The first part investigates the purpose of the use of SNS; the second part investigates usage times of the Internet and SNS; the third part investigates the information and the thoughts of individuals concerning the reliability and intervention of SNS to private lives of persons; and the fourth part covers personal/demographic information. Validity and reliability of survey were checked and Cronbach Alpha value was found as 0.901. The survey was applied to the sample group composed of consciously selected 180 SUPESTD students. The data of this quantitative and qualitative research were collected through a survey and an interview in two stages. Quantitative data were obtained through multiple-choice survey questions and qualitative data through open-ended questions in the survey and face-to-face interviews with “structured interview form”.

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Population and Sample
The population of research comprised students receiving Physical Education and Sports Teaching Education at SU in 2010 Fall Semester. In this context, students of physical education and sports teaching, sports administration, coaching, and recreation receive education on the same campus together. 193 students who will be teachers of children and the youth in the future were consciously selected as sample. The application was carried out by the researcher. 7 students could not be reached because of such reasons as being in national team training camps, illnesses and other reasons. Because 8 surveys were filled in wrongly and incompletely, they were eliminated and 180 surveys were evaluated.

Data Collection and Analysis
Survey and face-to-face interview were carried out by the researcher. Surveys were given to students one by one and filled surveys were collected instantly. Identity information was not taken so that the questions were answered objectively and the students were never intervened while answering the survey. Results obtained from the multiple options in the survey constituted the quantitative data. Besides, data obtained from open-ended questions in the survey and face-to-face interviews with structured interview form were evaluated with appropriate statistical calculations.

Data were evaluated by SPSS 15.0 program. Bartlett-Ball test was applied to decide whether there is the same variance for each variable by calculating factor analysis results made on survey variables, and Chi-square value was found 2391,740 and p value was found 0,000. This result showed that the data obtained was suitable for factor analysis.

KMO (Kaiser-Meyer-Olkin) test value of survey was found 0,859 and because this value is bigger than the value of 0,5 it was seen that the results of factor analysis were acceptable. Cronbach Alpha reliability parameter was checked to measure the reliability of factor analysis and this value was found 0,901. 8 dimensions were determined following the factor analysis results of variables in the usage scale of SNS.

Factor analysis and definitive statistics were used in the evaluation of working data. T-test and ANOVA test were used in comparison of qualitative data and Chi-square test was used in comparison of quantitative data. Results were evaluated in 95% confidence interval and at the p<0, 05 significance level.

Findings and Discussion
The findings of the study are as follows:

<table>
<thead>
<tr>
<th>Aims for using SNS</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Have no idea</th>
<th>Agree</th>
<th>Totally agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1: I have a good time.</td>
<td>4,4 10,0 16,7 57,2 11,7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S2: I guess the results of sports matches.</td>
<td>9,4 27,8 18,9 33,3 10,6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3: I meet new people.</td>
<td>15,6 21,7 10,0 40,6 12,2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S4: I share my photos and videos with people.</td>
<td>8,3 13,9 7,2 53,3 17,2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S5: I share/discuss developments on the agenda with my friends.</td>
<td>2,8 7,8 5,6 55,0 28,9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S6: I get rid of my loneliness.</td>
<td>17,8 27,8 19,4 27,2 7,8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S7: I can reach my old friends.</td>
<td>2,2 3,3 5,6 47,8 41,1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S8: I can express myself more comfortably.</td>
<td>8,9 28,9 18,9 32,8 10,6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S9: I can have a good time during the day.</td>
<td>7,8 13,9 22,2 44,4 11,7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S10: I can be informed about technical developments in Physical Education and</td>
<td>6,7 9,4 10,6 52,8 20,6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sports.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S11: I enjoy logging on these sites.</td>
<td>7,2 12,8 18,3 47,8 13,9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S12: I can share my feelings and opinions.</td>
<td>5,0 13,9 15,0 53,9 12,2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S13: I think I strengthen my social ties.</td>
<td>9,4 19,4 25,0 38,3 7,8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S14: I feel more peaceful and happier.</td>
<td>11,7 28,9 28,3 25,0 6,1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S15: I can learn what my friends are doing.</td>
<td>3,3 3,9 8,3 66,7 17,8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
When the answers on the purpose of use of SNS are analyzed, it is clear that 66.7% of the participants agree with the statement “I can learn what my friends are doing”, 57.2% agree with the statement “I have a good time”, 55.6% agree with the statement “I keep informed about sports organizations”, and 55.6% agree with the statement “I can reach funny/interesting photos, videos and notes”. When it is analyzed from another respect, 16.1% of the participants agree with the statement “I think I spare my time on good things”, 24.4% agree with the statement “I have the feeling that I am involved in a social group”, and 25.0% agree with the statement “I feel more peaceful and happier”. It can be understood from the table that the PESTD students are conscious users. The statement which is preferred at the highest level is related with friends, which shows that university students use SNS to realize communication and share among university students. And the statement which is preferred at the third level is related with sports and profession, and it shows that they use SNS properly. The most important thing is that the one which is preferred least is the statement “I think I spare my time effectively” and it indicates that they do not have the sense of belonging, and that it is not SNS that make them feel peaceful or happy and get rid of loneliness.

SNS which improve fast isolate individuals, especially children and the youth from their families and social and humane environments. And while they are getting into a virtual sociality, they begin to be in a distrustful mood to the outer life. PESTD students who seem to be aware of these risks can be said to be conscious users.

| S16: I keep informed about sports organizations. | 3,3 | 10,6 | 8,9 | 55,6 | 21,7 |
| S17: I am recognized more easily among colleges/students. | 9,4 | 20,0 | 22,8 | 34,4 | 13,3 |
| S18: I can reach funny/interesting photos, videos and notes. | 3,9 | 3,3 | 2,8 | 55,6 | 34,4 |
| S19: I can communicate with prominent people in my field. | 7,8 | 18,3 | 16,1 | 39,4 | 18,3 |
| S20: I can spend my free time. | 8,9 | 13,9 | 11,7 | 53,9 | 11,7 |
| S21: I can be away from the environment that makes me feel bored. | 12,2 | 21,7 | 19,4 | 36,1 | 10,6 |
| S22: I can look at the photos of my friends and see how much they change. | 2,8 | 4,4 | 3,3 | 56,1 | 33,3 |
| S23: I can keep informed about the events on Physical Education and Sports. | 3,3 | 13,3 | 11,7 | 53,3 | 18,3 |
| S24: I improve my culture of Physical Education and Sports. | 5,6 | 21,7 | 22,8 | 37,8 | 12,2 |
| S25: I can share my knowledge and opinions on Physical Education and Sports. | 5,6 | 20,0 | 16,7 | 46,7 | 11,1 |
| S26: I can find solutions to the problems I face in my profession field. | 6,1 | 21,7 | 21,7 | 37,2 | 13,3 |
| S27: I can learn the lives of people prominent in my field. | 5,6 | 20,0 | 17,8 | 41,1 | 15,6 |
| S28: I think I spend my time effectively. | 16,7 | 30,0 | 32,2 | 16,1 | 5,0 |
| S29: I can share my political and social opinions. | 16,7 | 24,4 | 11,7 | 37,8 | 9,4 |
| S30: I have the feeling that I am involved in a social group. | 16,7 | 34,4 | 16,1 | 24,4 | 8,3 |
| S31: I can share my comments on sports events. | 12,8 | 11,7 | 10,0 | 47,2 | 18,3 |

Table 2: Gender distribution of the participants

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>53</td>
<td>29.4</td>
</tr>
<tr>
<td>Male</td>
<td>127</td>
<td>70.6</td>
</tr>
<tr>
<td>Total</td>
<td>180</td>
<td>100.0</td>
</tr>
</tbody>
</table>

It was found that 70.6% of the participants are males, and 29.4% are females. Since female student applicants are admitted to SUPESTD at the rate of 1/3, therefore, the result is parallel to the strategy of admitting applicants. This result demonstrates that participants use SNS for similar reasons.

Table 3: The distribution of the place where the participants have lived during most of their lives

<table>
<thead>
<tr>
<th>Place where they have lived during most of their lives</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Cities</td>
<td>51</td>
<td>28.3</td>
</tr>
<tr>
<td>City</td>
<td>59</td>
<td>32.8</td>
</tr>
<tr>
<td>Town</td>
<td>56</td>
<td>31.1</td>
</tr>
<tr>
<td>Small town</td>
<td>4</td>
<td>2.2</td>
</tr>
<tr>
<td>Village</td>
<td>10</td>
<td>5.6</td>
</tr>
<tr>
<td>Total</td>
<td>180</td>
<td>100.0</td>
</tr>
</tbody>
</table>
It was found that 32.8% of the participants have lived in cities, 31.1% have lived in towns, 28.3% have lived in big cities. It can be generalized that most of the participants have lived in cities and towns. Nowadays, parents are trying to create an environment in which their children can enjoy good conditions, and so they prefer big cities instead of small places. Children, who can begin to do sports in their childhood, since they are supported by the opportunities of big city, live their lives in big cities through either their families or their clubs.

Table 4: The distribution of with whom the participants live

<table>
<thead>
<tr>
<th>With whom they live</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alone</td>
<td>11</td>
<td>6.1</td>
</tr>
<tr>
<td>With their friends</td>
<td>67</td>
<td>37.2</td>
</tr>
<tr>
<td>With their families</td>
<td>49</td>
<td>27.2</td>
</tr>
<tr>
<td>In a dormitory</td>
<td>51</td>
<td>28.3</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>1.1</td>
</tr>
<tr>
<td>Total</td>
<td>180</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The results show that 37.2% of the participants live with their friends, 28.3% live in a dormitory, and 27.2% live with their families. It is understood that the first choice of university students is to live with their friends. Sports students prefer living with their friends in private houses. Because of the reasons such as times of training, sports organizations, they may feel comfortable at home.

There is no statistically significant relationship between the distribution of purpose of use of SNS and their gender.

Table 5: The results of ANOVA test on the relationship between the purpose of use of SNS and the place where they have lived

<table>
<thead>
<tr>
<th>N</th>
<th>Average</th>
<th>Standard deviation</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big city</td>
<td>51</td>
<td>3.5218</td>
<td>.63271</td>
<td>2.407</td>
</tr>
<tr>
<td>City</td>
<td>59</td>
<td>3.3751</td>
<td>.49959</td>
<td></td>
</tr>
<tr>
<td>Town</td>
<td>56</td>
<td>3.4447</td>
<td>.54853</td>
<td></td>
</tr>
<tr>
<td>Small town</td>
<td>4</td>
<td>2.8629</td>
<td>.82384</td>
<td></td>
</tr>
<tr>
<td>Village</td>
<td>10</td>
<td>3.0677</td>
<td>.67433</td>
<td></td>
</tr>
</tbody>
</table>

There is no statistically significant relationship between the purpose of use of SNS and the place where they have lived. As there is an Internet access even in the villages, there are no place and time boundaries for logging into these SNS.

Table 6: The results of ANOVA test on the relationship between the purpose of use of SNS and with whom they live

<table>
<thead>
<tr>
<th>N</th>
<th>Average</th>
<th>Standard deviation</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alone</td>
<td>11</td>
<td>3.4076</td>
<td>.42116</td>
<td>1.081</td>
</tr>
<tr>
<td>With a friend</td>
<td>67</td>
<td>3.5156</td>
<td>.55472</td>
<td></td>
</tr>
<tr>
<td>With family</td>
<td>49</td>
<td>3.3094</td>
<td>.71718</td>
<td></td>
</tr>
<tr>
<td>In a dormitory</td>
<td>51</td>
<td>3.3599</td>
<td>.49169</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>3.6129</td>
<td>.04562</td>
<td></td>
</tr>
</tbody>
</table>

There is no statistically significant relationship between the purpose of use of SNS and with whom they live. And yet, in average, those who live with their friends use SNS more. It can be said that they encourage each other to talk to their mutual friends, to search for the things they wonder, or to communicate with their families.
Table 7: The frequency of the information and the thoughts of participants about the intervention of SNS to private lives of persons

<table>
<thead>
<tr>
<th>Their thoughts about whether social network sites intervene in private lives of persons</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>S40: I think social network sites (Facebook, Twitter, and YouTube etc.) are indispensable communication sources of our day.</td>
<td>12,8</td>
<td>22,8</td>
<td>15,6</td>
<td>28,9</td>
<td>20,0</td>
</tr>
<tr>
<td>S41: I think social network sites (Facebook, Twitter, and YouTube etc.) are secure sites.</td>
<td>16,7</td>
<td>27,2</td>
<td>30,6</td>
<td>18,9</td>
<td>6,7</td>
</tr>
<tr>
<td>S42: I think social network sites (Facebook, Twitter, and YouTube etc.) have more negative effects than positive effects.</td>
<td>7,2</td>
<td>17,2</td>
<td>29,4</td>
<td>30,6</td>
<td>15,6</td>
</tr>
<tr>
<td>S43: I think social network sites (Facebook, Twitter, and YouTube etc.) cause intervention of private life of persons.</td>
<td>7,2</td>
<td>18,3</td>
<td>16,1</td>
<td>41,7</td>
<td>16,7</td>
</tr>
<tr>
<td>S44: I think social network sites (Facebook, Twitter, and YouTube etc.) keep my personal information, photos, and videos safely.</td>
<td>16,7</td>
<td>24,4</td>
<td>29,4</td>
<td>21,1</td>
<td>8,3</td>
</tr>
<tr>
<td>S45: I see no harm to upload photos and videos to social network sites (Facebook, Twitter, YouTube etc.).</td>
<td>13,3</td>
<td>17,2</td>
<td>26,1</td>
<td>32,8</td>
<td>10,6</td>
</tr>
<tr>
<td>S46: I think social network sites (Facebook, Twitter, and YouTube etc.) take necessary precautions to protect my photos and videos.</td>
<td>18,3</td>
<td>21,7</td>
<td>22,8</td>
<td>30,0</td>
<td>7,2</td>
</tr>
<tr>
<td>S47: I am concerned that unwanted persons and/or the people I don’t know can reach my information, photos and displays through social network sites (Facebook, Twitter, YouTube etc.).</td>
<td>11,7</td>
<td>20,6</td>
<td>13,9</td>
<td>40,0</td>
<td>13,9</td>
</tr>
</tbody>
</table>

When the answers of participants about the intervention of SNS to private lives of persons are analyzed, participants agreed with the statement “I think social network sites (Facebook, Twitter, and YouTube etc.) are indispensable source of communication of our day” at the rate of 48.9%.

43.9% agree with the statement “I think social network sites (Facebook, Twitter, and YouTube etc.) are secure sites” but 30.6% are undecided. This result is an indication that half of the youth find SNS highly unsecure.

46.2% agree with the statement “I think social network sites (Facebook, Twitter, and YouTube etc.) have more negative effects than positive effects”. It is seen that 29.4% are undecided. According to this result, although students are users, they are aware of the negative sides of SNS.

58.4% agree with the statement “I think SNS social network sites (Facebook, Twitter, and YouTube etc.) cause intervention of private life of persons”. This result indicates that the youth perceive SNS as an intervention factor to their private lives.

There is a result indicating that 41.1% do not agree with the statement “I think social network sites (Facebook, Twitter, and YouTube etc.) keep my personal information, photos and videos safely”. With this result they confirm their opinions about the unreliability of SNS.

43.4% agree with the statement “I see no harm to upload photos and videos to social network sites (Facebook, Twitter, and YouTube etc.).” This result is surprising because it can be thought that participants make sharing only with wanted ones by limiting, constituting a password or barriers in their special accounts.

40% do not agree with the statement that “I think social network sites (Facebook, Twitter, and YouTube etc.) take necessary precautions to protect my photos and videos”. It shows that SNS are perceived as unsecure, inconsiderate, and imprudent.

53.9% agree with the statement “I am concerned that unwanted persons and/or the people I don’t know can reach my information, photos and displays through social network sites (Facebook, Twitter, and YouTube etc.).” This result indicates that PESTD students do not trust SNS.
Table 8: T test results of the relationship between the information and thoughts of individuals and gender in terms of the intervention of SNS to private lives of individuals

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Average</th>
<th>Standard deviation</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td>53</td>
<td>2,9858</td>
<td>.50219</td>
<td>-1.468</td>
<td>.144</td>
</tr>
<tr>
<td>Men</td>
<td>127</td>
<td>3,1201</td>
<td>.58086</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A statistically significant relationship was found between information and thoughts of individuals and gender in terms of the intervention of SNS to private lives of individuals. This result may root from the parallelism of opinion that common opinions of both groups are in the direction that SNS intervene in their private lives.

Table 9: The distribution of the SNS mostly used by participants

<table>
<thead>
<tr>
<th>Mostly used SNS</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facebook</td>
<td>88</td>
<td>48.9</td>
</tr>
<tr>
<td>Twitter</td>
<td>33</td>
<td>18.3</td>
</tr>
<tr>
<td>YouTube</td>
<td>16</td>
<td>8.9</td>
</tr>
<tr>
<td>Netlog</td>
<td>20</td>
<td>11.1</td>
</tr>
<tr>
<td>Windows Live</td>
<td>15</td>
<td>8.3</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>4.4</td>
</tr>
<tr>
<td>Total</td>
<td>180</td>
<td>100.0</td>
</tr>
</tbody>
</table>

48.9% of the participants use Facebook, 18.3% use Twitter, and 11.1% use Netlog. This result coincides with the result reported by Göker et al (2010). Having over 350 million users, Facebook is the most known social network on the Internet.

Table 10: The distribution of the intended uses of the Internet by participants

<table>
<thead>
<tr>
<th>Intended uses of the Internet</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat</td>
<td>19</td>
<td>10.6</td>
</tr>
<tr>
<td>Playing game</td>
<td>36</td>
<td>20.0</td>
</tr>
<tr>
<td>Research and information</td>
<td>24</td>
<td>13.3</td>
</tr>
<tr>
<td>Entering SNS (Facebook, Twitter YouTube etc.)</td>
<td>97</td>
<td>53.9</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>2.2</td>
</tr>
<tr>
<td>Total</td>
<td>180</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Intended uses of the Internet are as follows: 53.9% of participants enter social network systems; 20% play games, and 13.3% do research and get information. It is evident that participants mostly use the Internet to communicate with each other and to share. This result coincides with the results reported by Göker et al (2010).

Table 11: The frequency of daily Internet use of participants

<table>
<thead>
<tr>
<th>Frequency of daily internet use</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than an hour</td>
<td>44</td>
<td>24.4</td>
</tr>
<tr>
<td>1-2 hours</td>
<td>73</td>
<td>40.6</td>
</tr>
<tr>
<td>3-4 hours</td>
<td>35</td>
<td>19.4</td>
</tr>
<tr>
<td>More than 4 hours</td>
<td>28</td>
<td>15.6</td>
</tr>
<tr>
<td>Total</td>
<td>180</td>
<td>100.0</td>
</tr>
</tbody>
</table>

40.6% of participants use internet for 1-2 hours daily, 24.4% for less than an hour daily, and 19.4% for 3-4 hours daily. The results show that the majority of participants use the Internet for 1-2 hour daily. It is clear that there is a concentration in the first two choices. The result coincides with the results reported by Göker et al (2010). In normal conditions, while these times of usage can be thought of as normal, it is known that this time increases in the case of intense information sharing such as homework, research, photo, video etc.

Table 12: The distribution of the relationship between the time spent for SNS by participants and time spent on the Internet

<table>
<thead>
<tr>
<th>Time spent to SNS</th>
<th>Less than an hour</th>
<th>1-2 hours</th>
<th>3-4 hours</th>
<th>More than 4 hours</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Less than an hour</td>
<td>36</td>
<td>43.4</td>
<td>31</td>
<td>37.3</td>
<td>7</td>
</tr>
<tr>
<td>1-2 hours</td>
<td>4</td>
<td>6.6</td>
<td>36</td>
<td>59.0</td>
<td>14</td>
</tr>
<tr>
<td>3-4 hours</td>
<td>2</td>
<td>9.5</td>
<td>3</td>
<td>14.3</td>
<td>14</td>
</tr>
</tbody>
</table>

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There is a statistically significant relationship between the time spent for SNS by participants and the time spent on the Internet (p<0.001). The time spent for SNS and spent on the Internet are parallel to each other and if the time spent on the Internet increases, time for SNS will increase, too. This result coincides with the results reported by Göker et al (2001).

Table 13: The distribution of the relationship between the time spent for SNS by participants and time for using SNS weekly

<table>
<thead>
<tr>
<th>Time spent for SNS</th>
<th>Use of SNS Weekly (Facebook, Twitter, and YouTube etc.)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-2 days</td>
<td>3-4 days</td>
</tr>
<tr>
<td>Less than an hour</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>38</td>
<td>45.8</td>
</tr>
<tr>
<td>1-2 hours</td>
<td>11</td>
<td>18.0</td>
</tr>
<tr>
<td>3-4 hours</td>
<td>4</td>
<td>19.0</td>
</tr>
<tr>
<td>4-5 hours</td>
<td>1</td>
<td>12.5</td>
</tr>
<tr>
<td>5 hours and more</td>
<td>1</td>
<td>14.3</td>
</tr>
<tr>
<td>Total</td>
<td>55</td>
<td>30.6</td>
</tr>
</tbody>
</table>

Chi-square=32,317, p=0.001

There is a statistically significant relationship between the time participants spend for SNS a day and the time for using SNS weekly (p<0.001). When the table is analyzed, the time participants spend for SNS daily affects the weekly usage time proportionally and it can be concluded that the more the daily usage time increases, the more weekly usage time will increase.

Table 14: The distribution of the relationship between home place of participants and the place where they log on the Internet mostly

<table>
<thead>
<tr>
<th>Hometown</th>
<th>From Home</th>
<th>From Internet cafe</th>
<th>From Work</th>
<th>From school</th>
<th>From mobile devices</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big City</td>
<td>34</td>
<td>66.7</td>
<td>5</td>
<td>9.8</td>
<td>2</td>
<td>3.9</td>
<td>51</td>
</tr>
<tr>
<td>City</td>
<td>40</td>
<td>67.8</td>
<td>6</td>
<td>10.2</td>
<td>2</td>
<td>3.4</td>
<td>59</td>
</tr>
<tr>
<td>Town</td>
<td>33</td>
<td>58.9</td>
<td>8</td>
<td>14.3</td>
<td>3</td>
<td>5.4</td>
<td>56</td>
</tr>
<tr>
<td>Small town</td>
<td>2</td>
<td>50.0</td>
<td>1</td>
<td>25.0</td>
<td>0</td>
<td>0.0</td>
<td>4</td>
</tr>
<tr>
<td>Village</td>
<td>3</td>
<td>30.0</td>
<td>2</td>
<td>20.0</td>
<td>1</td>
<td>10.0</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>112</td>
<td>62.2</td>
<td>22</td>
<td>12.2</td>
<td>8</td>
<td>4.4</td>
<td>180</td>
</tr>
</tbody>
</table>

Chi-square: 10,914; p=0.948

A statistically significant relationship is not present between home place of participants and the place where they log on the Internet mostly (p>0.05).

67.8% living in big cities, 67.8% living in cities, 58.9% living in towns, 50.0% living in small towns, and 30.0% living in villages mostly log on the Internet from their homes. Because the Internet can be accessed all over Turkey, individuals both living in villages and big cities prefer sharing by connecting to the Internet from home easily.
Table 15: The distribution of the relationship between with whom/where the participants live and the place where they log on the Internet mostly

<table>
<thead>
<tr>
<th>With whom to live</th>
<th>the place where they log on the Internet mostly</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>From home</td>
<td>From Internet cafe</td>
</tr>
<tr>
<td>Alone</td>
<td>9</td>
<td>81.8</td>
</tr>
<tr>
<td>With a friend</td>
<td>44</td>
<td>65.7</td>
</tr>
<tr>
<td>With family</td>
<td>30</td>
<td>61.2</td>
</tr>
<tr>
<td>In dormitory</td>
<td>28</td>
<td>54.9</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>50.0</td>
</tr>
<tr>
<td>Total</td>
<td>112</td>
<td>62.2</td>
</tr>
</tbody>
</table>

Chi-square: 26.902; p=0.138

There is a statistically significant relationship found between with whom/where the participants live and the place where they log on the Internet mostly. 81.8% living alone, 65.7% living with a friend, 54.9% living in a dormitory mostly log on the Internet from home.

CONCLUSION

We can say that the most loyal users of SNS on the Internet are university students in Turkey as in several countries of the world since they were invented. Virtual environments take the place of real communication and sharing. A considerable amount of time slot is spent for SNS and this is accepted as the reflection of being modern individual among the youth and of being an important part of daily life. Joining SNS and maintaining the communication in this way find approval among the youth increasingly. This research made for the assessment was carried out with the purpose of determining the thoughts of 180 undergraduate SUPESTD students in the fall of 2010 about their intended uses of SNS, their usage time for the Internet and SNS and reliability of SNS.

Data were obtained through the survey developed by the researcher and an interview. They were evaluated with SPSS 15.0 program. Factor analysis, T-test, ANOVA and Chi-square test were used in statistical evaluation. It was found in this research that the majority of participants are men; a great majority of them spend their time in cities and live with friends.

Contrary to the opinion that generally acceptable SNS are used to find old friends or relatives, first three factors as the usage purpose of these SNS are totally different. The participants mostly use SNS to know what his/her friends do (66.7%), to have good time (57.2%), and to be informed about sports organizations (55.6%). Purpose of the use of the Internet is to enter SNS (53.9%), and they stay in SNS parallel to the time spent on the Internet and they generally use the Internet for 1-2 hours daily (40.6%) or less than an hour (24.4%). In light of these data, it can be said that participants are conscious users of SNS and the Internet.

A statistically significant relationship was not found between the reason for using SNS and gender of participants and the place where they live. The Internet is an unrivalled product of fast developing technology of today, and SNS are among the factors contributing to the acceleration of the globalization process. Findings of the research support this reality since all participants, regardless of place, time and gender difference, showed the tendency to social networking usage in similar proportion. All in all, thanks to the internet and SNS, participants are able to reach not only any national or international information, but also people from all around the world, which is both a result and an example of globalization.

As in our day the Internet usage purpose of majority of the participants is to enter into SNS, the Internet is getting common and an important time slot of the daily life is allocated to the Internet, social sharing, and thus communication way of individuals are changing. One of the important reasons of this change is SNS which are developed, increasing in number and gradually becoming widespread.

As to the reliability of SNS which have gained a global qualification as its usage areas and aims have become increasingly widespread, some opinions of users of SNS were determined as follows: It causes intervention to their private lives (58.4%), its negative effects are more than positive effects (46.2%) and SNS are not reliable (43.9%). Despite the threat perceived as directed to personal information security, negative perception about these SNS and their thoughts about the intervention of SNS to their private life, it was determined that they were...
members of at least one of these sites and they spend much time on them. This proves that SNS are indispensable communication sources and an important technology opportunity in professional development despite all these negative perceptions.

SNS, growing fast thanks to the Internet, distance individuals and mostly children and the youth from their families, and real social and human environments with the same speed and even isolate them. Also, it is observed that it pulls users into virtual sociality and leads them into an unhealthy body caused by a step-wise long term inertia, a skeptic and insecure spiritual way. The number of users gradually increases despite all these risks. Especially children and the youth should see these negative sides, threats and risks and they should be conscious and rational users. Every individual should determine his usage strategy appropriate to his necessity. As long as it is used as goal-oriented and when necessary, facilities presented to us by technology are incontrovertibly many and beneficial.

The Internet and SNS present a means of communicating and sharing and provide fast and easy access to information by removing time and space constraints. It is essential to behave carefully and economically about the time spent for these time-consuming virtual environments to benefit from today’s technologies efficiently and not to be captured by SNS.

REFERENCES


OPINIONS OF UNIVERSITY GRADUATES ABOUT SOCIAL NETWORKS ACCORDING TO THEIR PERSONAL CHARACTERISTICS

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ABSTRACT
This research aims to determine opinions of university graduates about social networks according to their personal characteristics. The research was conducted on 203 university graduates who received teacher training at Sakarya University in 2010-2011 academic year. Two different data collection tools were administered to the participating university graduates and correlation analysis was conducted in light of data collected from the tools above. As is widely accepted by the technology users, Facebook, the most used social network in Turkey and across the world, was selected as the social network for the research. A positive and significant relationship was found among Facebook-related opinions stated by university graduates having an extravert personality as a result of data collected through the Eysenck Personality Questionnaire-Revised/Short-Form and Opinions of University Graduates about Social Networks data collection tools.

Keywords: Personality, Social networks, Facebook, Internet use

INTRODUCTION
The Internet has become the main information and data provider since its appearance at the end of the 20th century (Ozad & Kutoglu, 2010). The most effective communication resources, computers and the Internet, are part of our daily life and have become one of the important tools in the education (Sahin, Balta, & Ercan, 2010). There are a number of Web-based services and applications that demonstrate the foundations of the Web 2.0 concept, and they are already being used to a certain extent in education. These are not really technologies as such, but services (or user processes) built using the building blocks of the technologies and open standards that underpin the Internet and the Web. These include blogs, wikis, multimedia sharing services, content syndication, podcasting and content tagging services. Many of these applications of Web technology are relatively mature, having been in use for a number of years, although new features and capabilities are being added on a regular basis (Anderson, 2007).

Web 2.0 enables and facilitates the active participation of each user. Being attached to the Web 2.0 tool used, the users have a variety of rights about interacting with the content (Balkan Kiyici, 2010). Web 2.0 applications and services allow by individual (blogs) and collective (wikis) publishing and storing of textual information and audio recordings (podcasts), video material (vidcasts), of pictures, etc. Authoring of this user generated content is greatly facilitated by providing easy to use desktop-like interfaces. While some time ago, Web applications were easily distinguishable from their desktop counterparts due to their design and point-click-wait interaction, today's Web 2.0 applications are often recognizable as being Web application only at second glance (Ullrich, Borau, Luo, Tan, Shen, & Shen, 2008).

Social networks gain great importance following the development of web 2.0 technologies. Today, many individuals communicate with others using social networks in environments where face-to-face communications are not fully provided. They use the social networks as a way of entertainment and adapt social networks into their life styles. And also social networks is defined network sites as web based services that allow individuals to construct a public or semi-public profile within a bounded system, articulate a list of other users with whom they share a connection, and view and traverse their list of connections and those made by others within the system (Boyd & Ellison, 2008).

One of the websites that comes to mind first in terms of social networks is Facebook. Facebook is one of the three most visited web sites in the world in 2010 (Alexa, 2010). Founded in February 2004, Facebook is a social utility that helps people communicate with their friends, family and coworkers more efficiently. The company develops technologies that facilitate the sharing of information through the social graph, the digital mapping of people's real-world social connections. Anyone can sign up for Facebook and interact with the people they know in a secure environment (Facebook, 2010 a). 50% of the 500 million members all over the world regularly visit this social network platform each day (Facebook, 2010 b).

Despite the explosive growth in the number of Facebook users, the number of research investigating Facebook has not increased proportionally. Ellison and colleagues note, much of the research which currently exists investigates identity presentation and privacy concerns (Ellison, Steinfield, & Lampe, 2007).
Researches conducted revealed that attitudes towards internet and experiences in using internet had a correlational relation with using social networks more (Wellman, Haase, Witte, & Hampton, 2001; Ross, Orr, Sisie, Arsenault, Simmering, & Orr, 2009). Moreover Burt et al. drew the personality profile of “network entrepreneurs” by identifying the personality characteristics of individuals who possessed structural holes in their work Networks. Based on those personality characteristics, they concluded that network entrepreneurs prefer to be in authority, create excitement, and change things (Burt, Janotta, & Mahoney, 1998). Becker (2004) has argued that results regarding relations between personality and network behavior have usually been regarded as weak because personality does not have strong direct effects on behavior. Becker proposes that the effects of personality on network building are likely to be mediated by more proximal motivational antecedents, including attitudes, subjective norms and perceived control over network building. However, there are not many researches in the literature shedding light on the opinions about social networks according to personal characteristics and frequency of using social networks. Therefore, the research sought how the personal characteristics affect the opinions about social networks.

METHOD

In this section, information about the research model, data collecting tools, data collection and analysis is provided.

Research Model

The research was conducted through the general survey method. General survey models are survey designs to be administered on an entire population, a group selected from the whole population, sample or sampling in order to make a general judgment about the population consisting of many items (Karasar, 1995). Population of the research comprises the university graduates in Turkey and the sampling consists of the university graduates enrolled to receive teaching training certificate at Sakarya University, Faculty of Education.

Population and Sample

In the research conducted in order to determine the personal characteristics of the university graduates, the sample of the research was selected from university graduates who received teacher training at Sakarya University in 2010-2011 Academic Year. Appropriate sampling method was used for the sample selection. The Eysenck Personality Questionnaire-Revised Short-Form and the questionnaire developed by the researcher were administered to the randomly selected 220 university graduates and 17 questionnaires were excluded since university graduates did not use social networks. Data were evaluated through the 203 questionnaires. Distribution of the sample group by demographic characteristics is given in Table 1.

| Table 1 General Distribution of Participating University Graduates by Demographic Characteristics |
|-------------------------------------------------|------|------|
| Gender                                          | f    | %    |
| Female                                         | 139  | 68.5 |
| Male                                           | 64   | 31.5 |
| Marital Status                                  |      |      |
| Married                                        | 54   | 26.6 |
| Single                                         | 130  | 64.0 |
| Engaged                                        | 19   | 9.4  |
| Age                                            |      |      |
| 20-25                                          | 109  | 53.7 |
| 26-30                                          | 65   | 32.0 |
| 30 and over                                    | 29   | 14.3 |
| Level of Income                                |      |      |
| 0-1000 TL                                      | 103  | 50.7 |
| 1001-2000 TL                                   | 61   | 30.0 |
| 2001 TL and over                               | 39   | 19.3 |
| Weekly Internet Use                            |      |      |
| 0-3 Hours                                      | 77   | 37.9 |
| 3-6 Hours                                      | 60   | 29.6 |
| 6-9 Hours                                      | 26   | 12.8 |
| 9 Hours and over                               | 40   | 19.7 |

Distribution of the students by the universities of graduation is provided in the Table 2.

| Table 2 General Distribution of Participating University Graduates by the Universities of Graduation |
|-------------------------------------------------|------|------|
| Universities of Graduation                      | f    | %    |
| Samsun 19 Mayis University                      | 3    | 1.5  |
| Gazi University                                 | 5    | 2.5  |
| Marmara University                              | 1    | 0.5  |
| Atatürk University                              | 4    | 2.0  |
Two different data collection tools were used in the research. One of these tools is “the Eysenck Personality Questionnaire-Revised/Short-Form” which was developed by Francis and et. al (1992) and translated into the Turkish language by Karancı, Dirik and Yorulmaz (2007). Other one is the tool of “Opinions of the University Graduates about the Social Networks” which sought the opinions of the university graduates about the social networks.

The Eysenck Personality Questionnaire-Revised/Short-Form (EPQR-S) has a four factor structure including 24 items. Each factor composes of 6 items and gathers the personal characteristics of the individuals in terms of neuroticism, psychoticism, extraversion and lie scale. This four factor structure explains 38% of the total variance. The co-efficiency level of the scale was found sequentially as .78, .65, .42, .64 for extraversion, neuroticism, psychoticism, and lie scale dimensions and the test-retest consistency sequentially as .84, .82, .69 and .69. The relationship of the EPQR-S was assessed with Rosenberg Self Esteem Scale, the Egna Minnen Betraffande Uppfostran and Fear Survey Inventory in order to assess the validity of the scale. The findings supported the construct validity of the scale (Karancı, Dirik, & Yorulmaz, 2007).

Discriminative personality characteristics defined by Eysenck were found to be related to specific feelings and behaviors. And it was revealed that neuroticism was related to anxiety, fear, depression, low self-esteem, and a tendency towards emotional and irrational behaviors. Extraversion was associated to being social, going to parties, making jokes and having many friends, impulsivity, uncontrolled emotions, and sometimes unreliable personality traits. Finally, psychoticism was found to have relation with psychotism, aggression and antisocial behaviors, and insensitivity towards others. The lie subscale is a control scale by which the validity of the whole test is examined (Karancı, Dirik, & Yorulmaz, 2007).

The questionnaire “Opinions of the University Graduates about the Social Networks” developed by the researcher was initiated by forming the determination of the items by which effects of the personal traits on the frequency of using social networks could be measured and was sent to 4 specialists working as instructors in the Department of Computer Education and Instructional Technologies for the scope validity. A questionnaire including 15 items was prepared in line with the views received from the specialists. Since the most used social network in Turkey is Facebook, items in the questionnaire were compiled in respect of Facebook. The internal consistency coefficient of the questionnaire was found as .86.

Data Collection Tool

Data Collection and Analysis

After the sample group was determined, it was asked whether the university graduates receiving teaching training volunteered to participate in the research and the scale and questionnaire were given only to the volunteer students. Data were analyzed using SPSS 19 program.
FINDINGS

Correlation between the total points acquired from the items in the questionnaire “Opinions of the University Graduates about the Social Networks” aiming to investigate opinions of university graduates about social networks according to their personal characteristics and the sub-factors of the Eysenck Personality Questionnaire-Revised/Short-Form (EPQR-S) was examined.

Table 3. Correlation Coefficient Demonstrating the Relationship between the Extravert Personality Characteristics and Opinions About Social Networks

<table>
<thead>
<tr>
<th>Correlation Coefficient</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Using Facebook is important for me.</td>
<td>.202**</td>
</tr>
<tr>
<td>2. I use Facebook everyday.</td>
<td>.143*</td>
</tr>
<tr>
<td>3. I communicate with my friends on Facebook.</td>
<td>.092</td>
</tr>
<tr>
<td>4. I feel strange if I do not use Facebook.</td>
<td>.087</td>
</tr>
<tr>
<td>5. I feel curious about the shares of my friends on Facebook.</td>
<td>.025</td>
</tr>
<tr>
<td>6. Contacting my friends on Facebook makes me happy.</td>
<td>.026</td>
</tr>
<tr>
<td>7. Facebook is a great advantage for today’s people.</td>
<td>.091</td>
</tr>
<tr>
<td>8. Playing Games on Facebook makes me happy.</td>
<td>.151*</td>
</tr>
<tr>
<td>9. I can spend long hours on Facebook.</td>
<td>.197**</td>
</tr>
<tr>
<td>10. I share my psychological condition on Facebook.</td>
<td>.197**</td>
</tr>
<tr>
<td>11. I read opinions shared on Facebook.</td>
<td>.043</td>
</tr>
<tr>
<td>12. I encourage my friends to be a member of Facebook.</td>
<td>.185**</td>
</tr>
<tr>
<td>13. I share things on Facebook.</td>
<td>.149*</td>
</tr>
<tr>
<td>14. Being tagged by my friends on Facebook annoys me.</td>
<td>.026</td>
</tr>
<tr>
<td>15. Facebook affects today’s social relations negatively.</td>
<td>-.003</td>
</tr>
</tbody>
</table>

As seen in the Table 3, a significantly positive relationship was found between the points given by university graduates having extraversion personality characteristics for the items of the extravert personality characteristic in the EPQR-S scale and points given for the items “Using Facebook is important for me” \( (r = .202, p < .001) \), “I use Facebook everyday” \( (r = .143, p = .043) \), “Playing Games on Facebook makes me happy” \( (r = .151, p = .033) \), “I can spend long hours on Facebook” \( (r = .197, p = .004) \), “I share my psychological condition on Facebook” \( (r = .185, p = .009) \), “I encourage my friends to be a member of Facebook” \( (r = .149, p = .035) \) “I share things on Facebook” \( (r = .026, p = .035) \).

Table 4. Correlation Coefficient Demonstrating the Relationship between the Neurotic Personality Characteristics and Opinions About Social Networks

<table>
<thead>
<tr>
<th>Correlation Coefficient</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Using Facebook is important for me.</td>
<td>-.090</td>
</tr>
<tr>
<td>2. I use Facebook everyday.</td>
<td>-.037</td>
</tr>
<tr>
<td>3. I communicate with my friends on Facebook.</td>
<td>-.023</td>
</tr>
<tr>
<td>4. I feel strange if I do not use Facebook.</td>
<td>-.029</td>
</tr>
<tr>
<td>5. I feel curious about the shares of my friends on Facebook.</td>
<td>-.065</td>
</tr>
<tr>
<td>6. Contacting my friends on Facebook makes me happy.</td>
<td>-.084</td>
</tr>
<tr>
<td>7. Facebook is a great advantage for today’s people.</td>
<td>-.020</td>
</tr>
<tr>
<td>8. Playing Games on Facebook makes me happy.</td>
<td>-.014</td>
</tr>
<tr>
<td>9. I can spend long hours on Facebook.</td>
<td>-.057</td>
</tr>
<tr>
<td>10. I share my psychological condition on Facebook.</td>
<td>-.016</td>
</tr>
<tr>
<td>11. I read opinions shared on Facebook.</td>
<td>-.121</td>
</tr>
<tr>
<td>12. I encourage my friends to be a member of Facebook.</td>
<td>.018</td>
</tr>
<tr>
<td>13. I share things on Facebook.</td>
<td>-.047</td>
</tr>
<tr>
<td>14. Being tagged by my friends on Facebook annoys me.</td>
<td>.064</td>
</tr>
<tr>
<td>15. Facebook affects today’s social relations negatively.</td>
<td>.037</td>
</tr>
</tbody>
</table>

As seen in the Table 4, no correlational relationship was found between the points given by university graduates having neurotic personality characteristics for the items of the neurotic personality characteristic in the EPQR-S scale and the points given for the questionnaire in which they stated their opinions about Facebook.
Table 5. Correlation Coefficient Demonstrating the Relationship between the Psychotic Personality Characteristics and Opinions About Social Networks

<table>
<thead>
<tr>
<th>Correlation Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Using Facebook is important for me.</td>
</tr>
<tr>
<td>2. I use Facebook everyday.</td>
</tr>
<tr>
<td>3. I communicate with my friends on Facebook.</td>
</tr>
<tr>
<td>4. I feel strange if I do not use Facebook.</td>
</tr>
<tr>
<td>5. I feel curious about the shares of my friends on Facebook.</td>
</tr>
<tr>
<td>6. Contacting my friends on Facebook makes me happy.</td>
</tr>
<tr>
<td>7. Facebook is a great advantage for today’s people.</td>
</tr>
<tr>
<td>8. Playing Games on Facebook makes me happy.</td>
</tr>
<tr>
<td>9. I can spend long hours on Facebook.</td>
</tr>
<tr>
<td>10. I share my psychological condition on Facebook.</td>
</tr>
<tr>
<td>11. I read opinions shared on Facebook.</td>
</tr>
<tr>
<td>12. I encourage my friends to be a member of Facebook.</td>
</tr>
<tr>
<td>13. I share things on Facebook.</td>
</tr>
<tr>
<td>14. Being tagged by my friends on Facebook annoys me.</td>
</tr>
<tr>
<td>15. Facebook affects today’s social relations negatively.</td>
</tr>
</tbody>
</table>

As seen in the Table 5, no correlational relationship was found between the scores given by university graduates having psychotic personality characteristics for the items of the psychotic personality characteristics in the EPQR-S scale and the points given for the questionnaire in which they stated their opinions about Facebook.

Table 6. Correlation Coefficient Demonstrating the Relationship between the Lying Personality Characteristics and Opinions About Social Networks

<table>
<thead>
<tr>
<th>Correlation Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Using Facebook is important for me.</td>
</tr>
<tr>
<td>2. I use Facebook everyday.</td>
</tr>
<tr>
<td>3. I communicate with my friends on Facebook.</td>
</tr>
<tr>
<td>4. I feel strange if I do not use Facebook.</td>
</tr>
<tr>
<td>5. I feel curious about the shares of my friends on Facebook.</td>
</tr>
<tr>
<td>6. Contacting my friends on Facebook makes me happy.</td>
</tr>
<tr>
<td>7. Facebook is a great advantage for today’s people.</td>
</tr>
<tr>
<td>8. Playing Games on Facebook makes me happy.</td>
</tr>
<tr>
<td>9. I can spend long hours on Facebook.</td>
</tr>
<tr>
<td>10. I share my psychological condition on Facebook.</td>
</tr>
<tr>
<td>11. I read opinions shared on Facebook.</td>
</tr>
<tr>
<td>12. I encourage my friends to be a member of Facebook.</td>
</tr>
<tr>
<td>13. I share things on Facebook.</td>
</tr>
<tr>
<td>14. Being tagged by my friends on Facebook annoys me.</td>
</tr>
<tr>
<td>15. Facebook affects today’s social relations negatively.</td>
</tr>
</tbody>
</table>

As seen in the Table 6, no correlational relationship was found between the points given by university graduates with lying personality characteristics for the items of the lying personality characteristic in the EPQR-S scale and the points given for the questionnaire in which they stated their opinions about Facebook.

CONCLUSION
The purpose of the present study was to investigate the influence of personality on Facebook use. Consistent with previous researches, findings indicated that personality variables were associated with some aspects of Facebook use. For example, individuals in the high Extraversion group reported membership in significantly more Facebook groups than individuals in the low Extraversion group (Ross, Orr, Sisic, Arsenault, Simmering, & Orr, 2009). Individuals high on the trait of Extraversion were found to belong to significantly more Facebook groups. And also extraverts are more likely to engage in social activities (Costa & McCrae, 1992).

In this research, it stands out that university graduates with extraversion personality characteristic gave more positive responses to some items related to using Facebook in comparison those with psychotic, neurotic and lying personality characteristics. In light of the findings of the research and with reference to the literature, it could be stated that individuals with extravert personality characteristics set communication using social
networks. However, no findings could be acquired between individuals with other characteristics and using social networks.

University graduates with extravert personality characteristic expressed that Facebook is important for them, they use Facebook everyday, playing Games on Facebook make them happy, they spend long hours on Facebook, they share their psychological conditions on Facebook, they encourage their friends to be a member of Facebook and they share things on Facebook. When these characteristics were assessed, it can be concluded that university graduates with extravert personality characteristics use Facebook to communicate and spend time and share their status.

Today, given that the importance of the social networks and number of users are on the increase it can be suggested to encourage individuals other than extravert personality characteristic to use social networks, develop applications addressing to all types of personality characteristics and not to regard the social networks as a barrier in front of the socialization.

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STUDENT TEACHERS SOCIALIZATION DEVELOPMENT BY TEACHING BLOG: REFLECTIONS AND SOCIALIZATION STRATEGIES

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ABSTRACT
This study aims to probe into the cognitive sources and reflective content of student teachers’ socialization, such as job proficiency, goals and values, school culture, and role regulation by ‘teaching blog’. This paper utilizes eight student teachers of business, data processing, Chinese, English, science, and technology as subjects. Through Action Research, this study examines educational practices related to teaching practices, home teacher practices, administrative practices, and service learning from teaching blogs constructed by student teachers and online feedback. Moreover, this study collects qualitative data via in-depth interviews, tour visits, school meetings, teaching demonstrations, practice communications, and mail and analyzes the data with software by ATLAS.ti. Findings demonstrate as follows (1) student teachers’ teaching demonstration can enhance the socialization strategy of ‘job proficiency’; (2) teaching blog can present student teachers’ dialogues and feelings regarding ‘goals and values’ in the virtual community; (3) student teachers’ cognitive sources for socialization strategies of ‘school culture’ is based on peer student teachers, mentor teachers, and internet communities; and (4) socialization strategy of ‘role regulation’ is based on teacher certification and school expectations.

Key Words: student teacher, socialization development, teaching blog.

INTRODUCTION
‘Socialization’ refers to the adjustment of individual acceptance of organizational rules and culture. Teacher socialization refers to the influential processes of professional rules, teacher culture, and school environment on teachers in professional groups (Deng, & Yuen, 2011; Killeavy & Moloney, 2010). For student teachers, educational practice indicates the transformational process from novice to expert teacher. Student teacher reflections on educational practice content, competitive educational goals and judgmental thinking on educational practices are approaches to develop educational socialization (Berliner, 2001; Howard, 2002; Mule, 2006).

Chou and Shen (2007) found that student teachers’ perceived pressures in socialization include the new measures of teacher education and preparations for teacher re-testing. Practical experience gained during the transition from novice teacher to expert teacher and socialization activities that construct learning beliefs include the following phases: ‘external support’, ‘transitional’, and ‘self-regulatory’. Socialization strategy refers to novice teachers’ organizational socialization learning under mentor instruction. Learning adjustments during socialization include job proficiency, goals, values, school culture, interpersonal relationships, historic rules, and role language (Calderhead & Robson, 1991; Deng, & Yuen, 2011).

Teaching blogs are public WebPages created by individuals or groups which contents may include citation of shared topics, creation, feedback, and review. Connections and exchanges occur between blogs posted on an internet platform as online members to share their feelings, articles, pictures, etc. (Chiou & Lee, 2008; Halic, Lee, Paulus, & Spence, 2010; Xie, Ke, & Sharma, 2008). Blogs can develop into online virtual communities for the purpose of social relationships. E-media allows members to share similar values and interests, without the limitations of time or space, where they interact and construct online interpersonal relationships (Lin, Lin, & Huang, 2008; Xie, Ke, & Sharma, 2008).

Past studies have indicated the learning effect of teaching blogs for online learners (Crippen & Earl, 2007; Du, & Wagner, 2006; Ebner, Lienhardt, Rohs & Meyer, 2010; Halic, Lee, Paulus, & Spence, 2010; Hall & Davison, 2007; Killeavy & Moloney, 2010; Kim, 2008; Romm, Pliskin & Clarke, 1997; Weller, 2007; Xie, Ke & Sharma, 2008). Teaching blogs, as the platform of student teacher online learning communities, aim to probe into interactions of virtual communities and analyze teacher professional development (Chang, & Liu, 2008; Deng, & Yuen, 2011; Killeavy & Moloney, 2010). Student teacher reflections posted on blogs have positive influence on the growth of professional knowledge and capacity. The reflection content is based on ‘students’ and ‘practice teachers’. Various researches have treated one-year practice teachers as subjects, and probed into vocational practice teacher socialization activities. In student, contact, adjustment, and integration phases, there are different socialization strategies (Chou & Shen, 2003).

Some studies suggest that student teacher interactions with mentor teachers, peer student teachers, and students in practice schools can influence the outcome of socialization (Killeavy & Moloney, 2010; Ward & McCotter,
In the past, advisers could only learn of student teachers’ socialization activities by tour guidance, practice journals, and student teachers meetings in schools. They could effectively control socialization in practice schools only by student teachers sharing their experiences in meetings and interviews or according to advisers’ rich and sensitive experience from tour guidance and practice journals. Educational practices for the new teacher educational system are changed from one year to a half year of Teacher Education Law in Taiwan (Ministry of Education of Taiwan, 2004). Therefore, if advisers can immediately control student teachers’ socialization processes and properly guide them, it would enhance student teachers’ socialization development.

Teaching blogs save educational practice data uploads, and allow communities to post feedback and have discussions (Chang, & Liu, 2008; Halic, Lee, Paulus & Spence, 2010; Joshi, & Chugh, 2009; Karatas, 2008; Lin, 2009; Maor, 2003; Ray, & Coulter, 2008; Ray & Hocutt, 2006a). Through student teaching blogs, this study aims to analyze student teachers’ cognitive sources and reflective content regarding socialization in educational practices. Moreover, this study intends to probe into interpersonal relationships in socialization, as based on internet community interactions on teaching blogs. Through teaching blogs and traditional educational practices, advisers can learn about student teacher interactions with teachers, students, and peers in practice schools, as well as interpersonal relationships in virtual communities. Based on the research motives above, this study analyzes student teachers’ cognitive sources and reflection content of job proficiency, goals, values, school cultures, and role regulations. Based on the findings, suggestions are proposed as criteria for teacher education institutions regarding systematic planning of educational practices.

PURPOSES OF THIS STUDY
According to the research background described above, this study explored the socialization development of student teachers by teaching blog. Specifically speaking, the purposes were:

1. To explored student teachers’ cognitive source and content of reflections.
2. To analyze student teachers’ socialization strategies.

REVIEW OF LITERATURE
Theories Teacher Socialization
The professional socialization of teachers is a continuous process of development in which student teachers become professionals in their field. In Taiwan, the process can be divided into three stages: the student stage, the initiation stage, and the teaching stage (Wang, 1991; Yang, Ou, Wang, Tang, & Liu, 1992). Professional socialization of teachers represents the process through which an individual internalizes professional abilities, professional attitudes and a sense of professionalism. There are several theories that can be used to interpret the processes and content of professional socialization. The most frequently adopted are Functionalism, Conflict Theory and the Theory of Symbolic Interaction (Cherubini, 2009; Wang, 1994; Zeichner, & Gore, 2010).

Advocates of Functionalism think society exists prior to the individual because people and their activities are regulated under the social systems. Individual behavior is gradually shaped by the expectations and approval of others. The theory of Functionalism assumes that hierarchical mechanisms can form every type of role and personality demanded by the process of socialization. In other words, each member of society has consistent beliefs and values under hierarchical structures. Functionalism identifies three factors which shape individual socialization: (1) Social regulations and values are equipped with the characteristics of equality, harmony and integration; there are rarely changes or conflicts. (2) Human nature is passive; people in social hierarchical structures cannot actively construct their roles; instead, they merely accept social regulations and values and play roles to meet social expectations. (3) In an interactive process, personal roles are influenced not only by the immediate social system but also by the larger system in which it is embedded (Deng, & Yuen, 2011; Ponte, Ax, Beijaard, & Wubbles, 2004; Wang, 1994; Zeichner, & Gore, 2010).

Advocates of Conflict Theory emphasize analyzing unstable states of social orders, i.e., conflicts in a society. The focus is different from that of Functionalism, which enhances the balance and harmony of social orders. Supporters of Conflict Theory maintain that each society is undergoing a process of change. This is not exactly an unhealthy scenario. Sometimes the process of integration can cause the reorganization and reordering of an organization to establish more efficient value systems or regulations. Neither important point of Conflict Theory is that a person does not need to abide by the roles assigned by social organizations or even accept social regulations. People can take the initiative to shape their roles through activities in a democratic society, and this may further alter the social system and regulations (Berliner, 2001; Calderhead, & Robson, 1991; Holadley, & Ensor, 2009; Killeavy, & Moloney, 2010).

Advocates of the Theory of Symbolic Interaction assume a society is composed of a group of interactive people.
Interpersonal interactions conclude classify symbolic icons in the interactive process of societies and interpret of practice (Johnston, & Witherill, 2002; Mule, 2006). In other words, in the interactive process, symbol systems deliver interactive messages. The agents who send the symbols define the meanings of the symbols, which are decoded by a receiver and given meaning by an individual’s subjective understanding. This kind of subjective decoding system is embedded in a unique personal, subjective, and contextual interpretation. Nevertheless, every individual has the ability to understand and play other roles, including that of the sender, which gives everyone the ability to understand the messages the sender delivers. In the interactive process, people develop a decoding system to understand each other’s meanings, i.e., contextual definitions. Thus, people can eventually develop themselves and manifest behaviors that are consistent with social values. This is the process of socialization.

Student Teachers’ Socialization

Research on the socialization of student teachers mostly concentrates on the initiation stage. Student teachers in elementary schools or secondary schools are the subjects. Kocoglu (2008) found that teachers’ professional development was continuous. The most important factors affecting teachers’ sense of professionalism were the schools they taught in and society in general (Bayram, Deniz, & Erdorgan, 2008; Teo, 2009). The research noted ‘teaching’, ‘classroom management’, ‘teaching materials, insufficient conditions and overload’ trouble student teachers most. There was a significant relationship between student teacher distress, personal traits and school they served. In particular, what caused student teachers the most distress was their unwilling enrollment in teachers colleges, their grades during their course of study, and the environment of the schools or communities to which they were sent (Gulbahar, 2008; Kocoglu, 2008; Lee, 2005; Mule, 2006; Taiwo, 2009; Teo, 2009).

Scholars indicate that the problems student teachers encounter include the teaching process, classroom management, teaching facilities, insufficient resources, excessive workloads, teaching unfamiliar subjects, doing research on teaching, the application of teaching methods, curriculum design, the establishment of teaching concepts, unfamiliarity with teaching materials, the application of teaching media, the ability to do research, and test design skills. These problems can be solved if student teachers develop self-regulated learning abilities, which have close links with the individual’s observation of his or her own leaning process (Cherubini, 2009; Flores, 2001; Hansen, 1995; Kocoglu, 2008; Taiwo, 2009; Ward & McCotter, 2004). Therefore, developing student teacher perception of the efficacy of the teaching process is an important factor to consider when setting up a comprehensive counseling system for the internship. It is also crucial to improve the faculty’s quality that the quality of faculty student teachers interact with mentors faculty members and lead teachers. Enhancing student teachers’ perception of teaching is urgent.

Holadley and Ensor (2009) explored the socialization of student teachers through the perspectives of ‘theory and practice’, ‘operation of school’, ‘classroom life and teaching classrooms’, and ‘informal regulations of teachers groups’. They found that pressure from schools and parents influenced portions of student teacher teaching beliefs and styles. As for classroom management, student teachers still maintained a ‘humanism orientation’ and ‘liberal attitudes’. Informal regulations from teacher groups affected student teacher values and attitudes. Johnston and Witherill (2002), reviewing studies regarding student teachers in the past ten years, pointed out that the issues that most distressed student teachers were ‘classroom management’ and ‘teaching’. Student teachers frequently consulted senior teachers when encountering difficulties.

To sum up, in order to understand and become accustomed to school environments, student teachers were often unable to prepare subject contents properly and often could not focus on the most important curricular contents. As a result, they could not easily match theory with practice. Due to such multidimensional problems as insufficient teaching experience, unfamiliarity with teaching subjects, lack of knowledge of classroom management and adaptation to new environments, student teachers had flaws and difficulties in their teaching. Consequently, student teachers searched for information in an attempt to understand learning contents, and they used adaptation strategies to make adjustments via collected information and reflective behaviors.

Teaching Blog and Teacher Socialization

The positive effects of blogging on critical reflection have been reported in several studies that have explored the application of blogs in student education and noted that the depth and breadth of student reflectivity were enhanced via blogs (Chai & Kim, 2010; Chang, & Liu, 2008; Churchill, 2009; Crippen & Earl, 2007; Deng & Yuen, 2009; Du & Wagner, 2006; Ebner, Lienhardt, Rohs & Meyer, 2010; Killeavy & Moloney, 2010; Kim, 2008; Kocoglu, 2008; Lee, 2005; Marks, 2007; Ray & Hocutt, 2006b; Ray & Coulter, 2008; Yang, 2009; Zeichner, & Gore, 2010). Lin (2009) conducted an empirical case study through questionnaires to understand the degree of teacher self-disclosure and self-disclosure support; he conducts quantitative analysis based on two-way analysis of variance to evaluate the affect of teachers’ subjective well-being emotion and teaching effectiveness. The results found that it has obvious interaction effects between ‘degree of self-disclosure’ and ‘self-disclosure
Yang (2009) indicated that through blogs as a teaching platform for teachers to promote positive and critical reflection effectively. Chan’s & Ridgway’s (2005) use of blogs demonstrated that blogs could support the communication between tutor and students. Blogs were introduced as a tool for students to develop their communicative, reflective and technological skills and to serve as a channel for teachers to communicate with students in addition to face-to-face meetings. Ray and Hocutt (2006a) used a sampling tool that sought to code the ‘depth’ of reflection accruing on each blog sampled by scoring each entry on a numeric scale. Their results found that the level of reflection-on-practice varied both within individual blogs as well as from blog to blog. Goh, Quek and Lee (2010) explained students’ perceptions of the learning benefits of blogging these are four factors, namely, efficiency, deliberation, de-personalization, and collaboration that.

Lai & Chen (2011) research blogs of the eight factors adopted by secondary school teachers in Taiwan, are perceived enjoyment, codification effort, compatibility, perceived ease of use, personal innovativeness, enjoyment in helping others, school support and perceived usefulness. “Blogs can support self-expression, self-reflection, social interaction, and reflective dialogue on the part of student teachers and the interactive functionality of blogs was used mostly for exchanging social support rather than reflective dialogue” (Deng & Yuen, 2009:p.877). Weblogs’ can support collaborative nature towards the development of these personal networks and forming a community of practice (Ebner, Lienhardt, Rohs & Meyer, 2010; Kim, Song, & Jones, 2011). Chai, & Kim (2010) found that trust was a key element of bloggers’ sharing knowledge.

To sum up, to see that other researchers had considered the use of weblogs as a reflective tool in student teacher socialization development context. It positioned this research plan as not unique, but contributing toward a better understanding of a topic currently under-researched. The educational affordances of blogs validated through this investigation can contribute to our understanding concerning the potential, strength and limitations of these student teachers in the arena of educational media. Insights gleaned can guide educators and researchers, especially those in the field of teacher education, to better capitalize on the expressive and communicative capabilities of blogs in support of teaching and learning.

**METHODODOLOGY**

**Participants**

The subjects of this study were eight student teachers in the new teacher educational system, with various backgrounds including business management, data processing, Chinese, English, science, and technology. Two factors were used to select the subjects:

First, regarding student teachers’ prior experiences within the new educational system, during student education ‘teaching practice’ courses were offered by the researcher; and during the practice, student teachers were assigned to a practice school for three weeks (12 hours). Thus, they would have prior understanding of practice school activities. In order to avoid the influence of teachers’ different control variables, such as their teaching devotion, teaching experience, personality traits, and educational background on the implementation outcome, the researcher served as the mentor teacher for eight student teachers during ‘educational practice’.

Secondly, regarding the selection of practice schools, the researcher selected schools that signed the contract with the teacher education center. In Action Research, the researcher followed the program of teacher education institutions, and then conducted design and implementation of the action research, as well as contact with teachers in practice schools. The teacher education center has been cooperating with practice schools for years. It could provide immediate suggestions regarding student teachers’ socialization processes, and could function as criteria for adjusting educational practices.

**Research Method**

This study probes into student teachers’ socialization by teaching blogs of action research. Action Research is applied in order to substantially assist with the participants. By teaching blogs constructed by student teachers in the action, advisers could immediately realize student teachers’ possible practice obstacles and interpersonal interactions. Thus, advisers could actively provide suggestions and solutions, and successfully guide student teachers to develop professional socialization. Action research is conducted based on four constructs of the teaching model of the Cognitive Apprenticeship Theory and educational practices during student teachers’ educational practice (six months), the procedure of action research in Fig. 1, and includes four phases, as follows.

First, based on the Cognitive Apprenticeship Theory, Action of Cognitive Apprenticeship is designed. According
to content, approach, sequence, and social of Cognitive Apprenticeship of Collins, Brown, and Newman (1989), this study designs educational practice activities through “blending” concept of courses.

Secondly, student teachers participate in action research of educational practices and the construction of teaching blogs. Units of action educational practices include the following, teacher-to-be study group, mentor-apprentice meeting, communication guidance, return-to-school interview, teacher-to-be teaching demo, and simulated oral test of teacher selection. Student teachers first construct teaching blogs and upload practice journals and assignments regarding the actions of educational practices on teaching blogs.

Thirdly, regarding eight units of educational practice guidance, advisers observed student teachers’ cognitive sources, reflection content of job proficiency, goals, values, school cultures, and role regulations by action research.

Finally, student teachers’ cognitive content of socialization strategies and the researcher’s reflections are included. By teaching blogs, advisers could analyze student teachers’ socialization developments, their views, objectives, and solutions regarding the new teacher educational system, as well as the researcher’s reflections. Upon the instructor’s role, the researcher analyzed ‘reflection in action’, from perspective of Schön (1983). The researcher’s reflections are restricted by the context at the time. After action research, the researcher reflected on the members’ thoughts and actions, as well as group operations, in order to solve practical problems (Churchill, 2009; Rodgers, 2002; Schellens, & Valcke, 2006; Schweiker-Marra, Holmes & Pula, 2003).

Therefore, based on teaching blogs constructed by student teachers, on-site observations, interviews, and educational practices, qualitative data is collected. Teaching blogs include the files of educational practices and feedback. Educational practice includes learning a teaching demo, learning back-to-school guidance, tour guidance record, tour guidance network and mail guidance record, educational practice files, etc. Feedback includes community feedback and hosts’ feedback. The researcher analyzed student teachers’ socialization development by live video of teaching demo, pictures, recording scripts of in-depth interviews, journals of teaching practices, home teacher practice, administration practice, and advanced studies.

![Fig. 1 The procedure of action research](image)
Statistical Analysis

Upon the data collected, ATLAS.ti was used to effectively connect and explain the data. According to previous literature, this study constructed a coding table and registered coding for each key event. Student teachers’ teaching blogs and educational practices are encoded. Key event content was recorded for analysis of the teachers’ thought processes and learning styles. Common or unique phenomena among cases were generalized and analyzed, and further compared and analyzed with previous literature. Data were encoded for student teachers’ departments, namely, A. business; B. data processing; C. Chinese; D. English; E. science & technology data sources (1. teaching blogs; 2. interview; 3. on-site observation records; 4. practice related documents). Three coders test reliability by the “intercoder reliability” approach (Wimmer & Dominick, 2000). Reliability is .87. The formula is as shown below:

A. inter-rater agreement = \frac{2M}{N_1+N_2}

B. reliability = \frac{N*(\text{average inter-rater agreement})}{1+((n-1)^* \text{average inter-rater agreement})}

RESULTS

Student teachers’ cognitive sources and reflection content of ‘job proficiency’, ‘goals and values’, ‘school culture’ and ‘role regulations’ are shown in Table 1, and described as follows.

Job Proficiency

Student teachers’ cognitive sources of ‘job proficiency’ are based on study class, teaching demonstration, use of teaching equipments, and student teachers’ self-reflections. Reflection content of socialization strategy refers to mentor teachers’ corrections, peer student teachers’ feedback, students’ reactions, and grades. Student teachers’ review and improvement on students’ reactions are adjustments of job proficiency. The findings are similar to the results of Hall and Davison (2007), Joshi and Chugh (2009). Student teachers’ reflection contents in blogs are mainly related to students and themselves, and will enhance their growth of professional knowledge and abilities. Summary of the qualitative data is as shown below:

“\text{The professor at the teacher education center will watch my teaching today. A teaching demo is important for student teachers. I can demonstrate what I have learned during practice, and treat it as the evaluation criterion.} \text{“} \text{(C3)}

“\text{I failed the demo. The examples were few and it seemed that students did not understand what I have taught. The exam ended in disaster! \text{“} \text{. (A2)}}

“\text{Preparation for teaching demo is complicated, and in addition to the text, teachers should set the time of professor’s visit, borrow the equipment, make instructional tools, write the teaching plans, etc.} \text{“} \text{(B1)}

“\text{School teachers and student teachers participated in a teaching demo and offered suggestions. The teaching demo could be the first work of my “teachers’ career”! \text{“} \text{(C3)}

“\text{In Chinese typing unit, I expected that students should at least know how to type their names. Therefore, I asked some students to take apart their names. Most of them did a good job. However, all of them told me it was difficult and they failed the exam”. (E1)}

Goal and Value

Student teachers’ cognitive sources of ‘goals and values’ refer to teacher certification, teacher recruitment, and service. Their reflection content of “goals and values” includes student teachers’ busy practice life, reflections on practice goals and life values, control of review study groups, as related to teacher certification and care of practice unit supervisors. Findings of this study are the same as Xie, Ke, and Sharma (2008). Student teachers of the new system are significantly influenced by teacher certification, which demonstrates that through mentor teachers, student teachers learn expert knowledge and skills. They are devoted, capable of communication, have definite attitudes, values, and morality, with attitudes and belief in care and functions of professional development. They are also able to re-examine and adjust influences on others by reflection (Chai & Kim, 2010; Capasso & Daresh, 2000; Ebner, Lienhardt, Rohs & Meyer, 2010; Lin, Lin & Huang, 2008; Weller, 2007). Summary of qualitative data is shown below:

“We assisted with teacher recruitment at the registration Office of Academic Affairs. I was energized by so many student teachers participation in the exam. I should not only pass teacher certification, but also pass the exam to become a formal teacher next year.” (A2)

“I have been always busy. However, I have the most workload, as they said that I was competent. It was not true. We were all graduated from graduate schools; however, a full-time assistant could
not handle my work? Please don’t train me like this. I have had enough”. (A1)
“The study group will be at six o’clock on Wednesday evenings. From this week, we will be busy
on Mondays. Please don’t change the schedule on Mondays. We will be busy in practice and please
manage your time. The weather is changeable lately, please take care of yourself. There are only
three months left for teaching examination. Good luck!” (B1)
“With the guidance of the principal, the director, and the mentor teachers, as well as my efforts and
preparation, I will perform better next year”. (D1)

School Culture
Student teachers’ cognitive sources of ‘school culture’ mainly refer to student teachers peer and mentor teachers. Student teachers’ support the teaching demo, assist with school services, and engage in exchanges through internet communities, as teaching blog are cognitive sources of a socialization strategy. Student teachers’ reflection content of ‘school culture’ mainly indicates that students’ care about mentor teacher feedback. Student teachers significantly recognize school teachers’ support and care. Findings of this study are the same as Crow and Matthews (1988). By a mentor’s guidance and reflection, student teachers realize their new roles, and their responsibilities within the school culture, which indicates different challenges and reflections. Care of students, mentor teachers, and school teachers’ support and concern will enhance student teachers’ identification with school culture (Marks, 2007; Ray & Coulter, 2008; Teo, 2009; Xie & Sharma, 2008). Summary of qualitative data is shown as follows:

“The students kept cheering me up this morning. I felt so warm. Other student teachers helped me
improve my looks. Thank you! (By the way, they all looked nervous today) Without you, I would
not have succeeded in the demo!” (B1)
“It was finally finished. Thanks for the practice teachers’ participation. Your opinions will enhance
my progress. Moreover, I appreciate Teacher Lin’s help. The poster is great! “. (B1)
“Yes! The key part of the practice is finished! You have contributed a lot. You were the one who
maintained contact with mentor teachers. Thank you! (Jing Hsuan’s response at 10:39 AM,
November 15, 2008)” (C1)
“I was exhausted when I returned to the office. Mei chu (staff in Office of Academic Affairs) said
that you should have been exhausted! It was great that you accomplished the tasks of this stage. You
should keep studying” (Host’s response at 11:12 AM, November 15, 2008”). (C1)
“The internet is strange, people are interactive, information is shared, sharing happiness is
necessary..., I’m glad to meet you on internet. Your layout is great. We can exchange with each
other and don’t forget to leave messages!” (A1)
“Some teacher told me my students have good manners. I was happy. I had dinner with a teacher
who asked me if I was filled with happiness” (B1)
“It is a full of surprises day. The students have planned a birthday party for me. They and the
mentor teacher surprised me!” “Students took the cake and walked toward me. When I blew out the
游戏里的, I was really moved! “. (C1)
“When I returned to the office, other practice teachers congratulated me. They all envied me for
the gifts you gave! I was lucky to have you as a novice teacher! I am energized for the future. Thank
you~~~ my babies of business A class! “. (C1)

Table 1 Teaching blogs on student teachers’ cognitive sources and reflection contents of socialization
strategies

<table>
<thead>
<tr>
<th>Socialization strategies</th>
<th>Cognitive sources</th>
<th>Content of reflections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job proficiency</td>
<td>1. Study class and teaching demo</td>
<td>1. Mentor teachers’ corrections</td>
</tr>
<tr>
<td></td>
<td>2. Teaching activities and use of teaching equipment</td>
<td>2. Peer student teachers’ feedback</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Students’ reactions to teaching sites, reviews, and future improvements</td>
</tr>
<tr>
<td>Goals and values</td>
<td>1. Teacher certification, teacher recruitment, and services</td>
<td>1. Student teachers are busy with teaching</td>
</tr>
<tr>
<td></td>
<td>2. Control of review for study group related teacher certification</td>
<td>2. Recognizes the importance of educational practice by assisting with teaching test.</td>
</tr>
<tr>
<td></td>
<td>3. Practice unit supervisors’ care</td>
<td></td>
</tr>
<tr>
<td>School culture</td>
<td>1. Peer student teachers and mentor teachers</td>
<td>1. Care of students and mentor teachers</td>
</tr>
<tr>
<td></td>
<td>2. Support for teaching demo and assistance</td>
<td>2. Student teachers significantly recognize school teachers’ support and care</td>
</tr>
</tbody>
</table>
Role Regulation

Student teachers' cognitive sources of 'role regulations' are mainly based on mentor teachers' corrections and suggestions, as well as teacher-student interactions and peer interpersonal relationships. Student teachers' reflection contents of 'role regulation' are based on teacher certification. Findings of this study are similar to Xie, Ke, and Sharma (2008). The reason could be in that 'teaching blogs' enhance interpersonal communications. Moreover, in order to prepare for re-testing in the new teacher educational system, student teachers can try hard to socialize. Regarding role regulations, they will try to meet the expectations of the practice school (Killeavy & Moloney, 2010; Hall & Davison, 2007; Lee, 2005). Summary of qualitative data is shown below:

“The practice will finish and I feel sorry”. (B1)

“There are only two more months left in the practice. Besides learning teaching affairs, I should start preparing for teacher certification. I will only continue on this road by acquiring a teachers’ certificate!” (B1)

“It seems that your demo is getting better. I also made progress with the mentor teachers’ critique. I was nervous on stage. Thanks for your suggestion and the funny picture. I did not put it on my blog, so I will show you next time!” (E1)

“I sincerely appreciate mentor teachers. From the beginning of the semester, they have guided my teaching, my interpersonal relationship, and many details. Thus, I succeeded in my teaching demo today. I really appreciate them!” (E2)

DISCUSSION

Student teachers’ teaching demonstration will enhance ‘job proficiency’. Demo in practice, use of teaching equipment, peer teachers’ feedback, and students’ reaction will demonstrate the outcome of the teaching demo. Teachers’ self cognition and reflection will enhance job proficiency. However, in this study, student teachers’ sources of ‘job proficiency’ mainly refers to study classes and teaching demonstrations, including peer teachers’ feedback, students’ reactions, and student teachers’ self-cognition and reflection. Reflection content of socialization includes instructional activities, which is related to the use of instructional equipments and adjustment of perceptions of socialization strategies (Joshi, & Chugh, 2009; Lin, Lin & Huang, 2008; Mule, 2006; Zanting, Verloop & Vermunt, 2001). The reason is that prior to completing the practice, there is a teaching demo, which is related to the use of instructional equipment and labor-force arrangements. In order to accomplish ‘job proficiency’, student teachers will seek support and assistance, which will enhance job proficiency and reflection.

Teaching blogs will reveal student teachers’ dialogues and feelings on ‘goals and values’ in virtual communities. This study finds that the cognitive sources of student teachers’ ‘goals and values’ are as follows (1) teacher certification, teacher recruitment, and services; (2) control of review of study group related teacher certification; and (3) practice unit supervisors’ care; recognition of importance of educational practices by teaching test. Regarding student teachers’ feelings of their practice term, the researcher collects chat and values content in online communities of ‘teaching blogs’. Moreover, chatting in online communities by student teachers on teaching blogs demonstrate the learning patterns of peer learning communities of virtual study groups and student teachers’ actual psychological state (Chai & Kim, 2010; Deng, & Yuen, 2011; Du & Wagner, 2006; Schellens, & Valcke, 2006; Xie, Ke & Sharma, 2008).

Student teachers’ cognitive sources regarding ‘school culture’ socialization strategy mainly refers to student teachers peer, mentor teachers, and internet communities. Practice school students’ and mentor teachers’ care, school teachers’ support and concern, and internet community feedback and exchange on teaching blogs are one of the sources of school cultures, as perceived by student teachers. It demonstrates the importance of internet community feedback and exchange. Student teachers should continually examine the gap between teaching and goals. This study demonstrates that teachers’ personal reflections and inner motivations help to maintain their devotion to teaching and persistence to improve through peer student teachers and mentor teachers, and demonstrates the importance of feedback and exchange in internet communities. Student teachers should
continually examine the gap between their teaching and goals, and be sensitive to transitional information and problems (Chiou, & Lee, 2008; Romm, Pliskin & Clarke, 1997; Ward & McCotter, 2004; Ponte, Ax, Beijaard & Wubbles, 2004).

‘Role regulation’ is based on teacher certification and school expectations. This study finds that, in order to prepare for re-testing of the new teacher educational system, student teachers should strive to meet the requirements of the socialization strategy. Their cognitive sources in ‘role regulations’ are mainly sourced upon teacher-student interactions, peer interpersonal relationships, and mentor teachers’ corrections and suggestions in order to meet the expectations of the practice school. Foreign studies demonstrate the importance of mentors’ belief in the construction of student teachers’ socialization strategies. During interactions, in addition to interpersonal relationships and job proficiency, teachers should gradually develop the self, and their performance behaviors to meet school cultures and social values (Churchill, 2009; Holadley & Ensor, 2009; Killeavy, & Moloney, 2010; Lin, 2009; Maor, 2003).

**IMPLICATIONS**
This study proposed five suggestions as criteria for educational practice guidance in teacher education institutions.

1. Enhance student teachers’ teaching demo and their instructional reflections. This study found that for teaching demonstrations, student teachers should show their positive cognition and reflection content by daily demonstrations, teacher-student interactions, peer student teachers’ support, and mentor teachers’ suggestions. In order to meet new system of teacher education, teacher education institutions should help student teachers to apply diverse instructional strategies and practices in life experience. Diverse instructional strategies can function as feedback of teaching activities by reading, discussions, observations, field studies, autobiographies, journals, case studies, debates, appreciation, and inquiry, as well as action research. Student teachers should construct self reflection and professional dialogues with peers and become active learners.

2. Guide student teachers to construct teaching blogs and prepare for re-testing. Through teaching blogs, advisers could effectively control student teachers’ socialization developments. Teacher educational units should not only instruct student teachers to collect information related to practice schools, but also guide them to construct teaching blogs and prepare for re-testing, and develop time management skills. By arranging discussions of educational practices and simulation of re-testing, teacher educational institutions recognize role position and the construction of the educational profession during student teachers’ practice, thus, helping them to become mature educational workers.

3. Encourage student teachers to construct study groups in virtual communities. Study groups of virtual communities on teaching blogs, regarding ‘goals and values’ would enhance student teachers’ instructional reflections, and adjustments of the teaching test schedule. Teacher educational institutions should encourage student teachers to construct study group of peers in virtual communities in order to meet the new system of teacher education. Student teachers prepare for re-test and teaching examination by study groups on teaching blogs. Through teaching blogs, teachers have forums of professional experiences, theoretical dialogues with peer coaches of virtual communities, student teachers, peer teachers, expert teachers, and advisers. Through observing teaching blogs constructed by teacher education units, action observations of expert teachers and peer teachers, as well as peer coaches, such as collaborative actions of self reflection, this study learns student teachers’ practical reflections and intentions.

4. Help student teachers construct school culture-oriented internet communities for professional development. Student teachers’ participation in school services could enhance identification with ‘school culture’. Regarding ‘role regulation’, student teachers will consider teacher-student interactions and peer interpersonal relationships. Teacher education institutions should enhance student teachers’ professional knowledge through skill-based instructions, conceptual thinking instructions, collective study instructions, ladder practice-oriented instructions, and various instructional strategies. They should help student teachers to construct school culture-oriented internet communities for professional development, and assist student teachers to effectively master professional knowledge and abilities, which will turn into professional literacy and allow teachers to gain sufficient transitional and self-regulatory measures.

**LIMITATIONS**
Some limitations of this study should be mentioned. Firstly, this study used action research method. This sample of bloggers of student teacher has limited the generalizability of the research results. This may result in biases and lacks the cross-school population. Future research should conduct other collecting and sampling methods to correct the biases. Secondly, this study used cross-school student teachers, ignoring the possible effects of school and mentor teachers. Student teachers’ cognitive sources and reflective content on job proficiency, goals and values, school culture, and role regulation may need these supporting of mentor teachers. Future study could
conduct longitudinal studies to overcome this limitation. Thirdly, few researchers investigated student teachers’ trust and involvement in the teaching blogs of education practice. This study is an exploratory researcher. Future research could explore other effective e-tool of related to student teachers’ socialization. Lastly, some study point these influencing factors of student teacher’ teaching blog, involved in teacher training type, time of student teachers participating in the blog, but this study did not explore. Future study could investigate these influencing factors.

ACKNOWLEDGEMENTS
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THE CURRENT PERSPECTIVES, THEORIES AND PRACTICES OF MOBILE LEARNING

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ABSTRACT
Mobile learning (m-learning) is a highly popular multidisciplinary study field around the world. It has attracted a great deal of attention from researchers in different disciplines who have realized the potential to apply mobile technologies to enhance learning. Thus, mobile learning has been defined differently by different people. This study is a review of m-learning literature for understanding and discussion of current perspectives and theories in mobile learning. Additionally, some m-learning practices that are implemented in different sectors such as corporate, university and military have been mentioned.

Keywords: Mobile learning, m-learning theories and m-learning practices

INTRODUCTION
Mobile devices are commonly used all around the world. In some countries, mobile devices are much more widely used than computers. For instance, people in Kenya are able to use mobile devices everywhere to access the internet, check e-mail, make phone calls, send SMS messages, etc. Mobile learning has come to people’s attention because mobile devices are portable, ubiquitous, easily accessible and used by many people. This situation shows that there is great potential to enhance learning with mobile devices.

Mobile Learning Perspectives
Mobile learning (m-learning) is defined differently by different people. Early perspectives of m-learning were focused on technology, and defined as the delivery of training by means of mobile devices such as mobile phones, PDAs and digital audio players, as well as digital cameras and voice recorders, pen scanners, etc. For example, MoLoNET (2007) defined it as “The exploitation of ubiquitous handheld technologies, together with wireless and mobile phone networks, to facilitate, support, enhance and extend the reach of teaching and learning.” Another view of m-learning focuses on mobility. Keagen (2005) suggests that m-learning should be restricted to learning on small and portable devices. According to him, mobile devices could be carried everywhere. For example, a lady can carry in her handbag or a gentleman can carry in his pocket. So this definition also relates to a technocentric perspective because of concentrating on the size of mobile devices.

Some researchers characterise mobile learning as an extension of e-learning. For instance, Kadirire (2009) defines m-learning as a form of e-Learning, which can take place anytime, anywhere with the help of a mobile communication device such as a mobile phone, a personal digital assistant (PDA), iPod or any such small portable device. But new mobile learning perspectives accept m-learning as a paradigm change. One of these perspective is the learner-centred perspective. It asserts that m-learning is any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning opportuines offered by mobile technologies (O’Malley et al, 2003). The other perspective focuses on individualism. According to this perspective, m-learning is defined as any activity that allows individuals to be more productive when consuming, interacting with, or creating information, mediating through a compact digital portable device that the individual carries on a regular basis, has reliable connectivity, and fits in a pocket or purse (Wexler et al, 2008). There are some researchers who associate m-learning with ubiquitous learning, as well (Ng et al, 2009).

Finally, there are many different m-learning perspectives in the related literature. Each definitions focus on the different features such as mobile technologies, mobility, indvivialum, ubiquitous, or e-learning.

Mobile Learning Theories
Current mobile learning theories are Behaviorism, Cognitivism, Constructivism, Situated Learning, Problem-Based Learning, Context Awareness Learning, Socio-Cultural Theory, Collaborative Learning, Conversational Learning, Lifelong Learning, Informal Learning as well as Activity Theory, Connectivism, Navigationism, Location-based learning. All of these theories will be discussed in Table 1.
Table 1. Mobile Learning Theories

<table>
<thead>
<tr>
<th>Theories</th>
<th>Definitions</th>
<th>Focus</th>
<th>Examples with mobile technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behaviorist Learning</td>
<td>Learning has occurred when learners evidence the appropriate reinforcement of an association between a particular response and stimulus (Smith and Ragan, 2005)</td>
<td>Information and content delivery in mobile learning</td>
<td>English learning applications&lt;br&gt;<strong>SMS, MMS,</strong> <strong>Voice recorder softwares</strong>&lt;br&gt;Mobile Response System: Qwizdom, Turning Point Response System&lt;br&gt;Tell me tech. (searching)</td>
</tr>
<tr>
<td>Cognitivist learning</td>
<td>Learning is the acquisition or reorganization of the cognitive structures through which humans process and store information (Good and Brophy, 1990)</td>
<td>Information and content delivery in mobile learning</td>
<td>Multimedia (text, video, audio, animation, images)&lt;br&gt;SMS, MMS, e-Mail&lt;br&gt;Podcasting&lt;br&gt;Mobile TV</td>
</tr>
<tr>
<td>Constructive learning</td>
<td>Learning is an activity process in which learners construct new idea or concepts based on their current and past knowledge (Bruner, 1966)</td>
<td>Context and content-dependent mobile learning</td>
<td>Handheld games&lt;br&gt;Simulation&lt;br&gt;Virtual reality&lt;br&gt;Interactive Podcasting and SMS&lt;br&gt;Interactive mobile TV and SMS</td>
</tr>
<tr>
<td>Situated learning</td>
<td>Learning is not merely the acquisition of knowledge by individuals, but instead a process of social participation (Brown et all, 1989).</td>
<td>Social Context and Social participant dependent mobile learning</td>
<td>Natural science learning&lt;br&gt;Medical education&lt;br&gt;Multimedia museum&lt;br&gt;Virtual experts by artificial intelligence tech.&lt;br&gt;Mobile performance support system</td>
</tr>
<tr>
<td>Problem-based learning</td>
<td>Learning aims to develop students’ critical thinking skills by giving them an ill-defined problem that is reflective of what they would encounter as a practicing professional (Koschmann et all, 1996)</td>
<td>Problem based context and solved based content-dependent mobile learning</td>
<td>Medical education&lt;br&gt;Business administration&lt;br&gt;Nursing&lt;br&gt;Simulations&lt;br&gt;SMS&lt;br&gt;MMS&lt;br&gt;Voice responde systems</td>
</tr>
<tr>
<td>Context awareness learning</td>
<td>Context awareness means gathering information from the environment to provide a measure of what is currently going on around user an the device (Naismith et all, 2004)</td>
<td>Context aware in mobile learning</td>
<td>Multimedia museum and gallery&lt;br&gt;Pre-class podcasts&lt;br&gt;Films&lt;br&gt;e-books&lt;br&gt;Podcasting</td>
</tr>
<tr>
<td>Socio-cultural</td>
<td>Learning occurs first through</td>
<td>Social Context and Social</td>
<td>Mobile performance support</td>
</tr>
<tr>
<td>Theory</td>
<td>Description</td>
<td>Mobile Learning System</td>
<td>Features</td>
</tr>
<tr>
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<td>----------</td>
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<tr>
<td>Interpersonal (interaction with social environment) than intrapersonal (internalization) (Vygotski, 1978).</td>
<td></td>
<td>participant dependent mobile learning</td>
<td>Virtual experts, Mobile forum, E-mail, Social network (Web 2.0 tools)</td>
</tr>
<tr>
<td>Collaborative learning</td>
<td>Learning is promoted, facilitated and enhanced by interaction and collaborations between students.</td>
<td>Collaboration and interaction dependent mobile learning</td>
<td>Mobile Assisted Language Learning, Mobile Response System, Mobile computer supported collaborative learning Forum, Web 2.0 tools, e-mail, mobile portal, games</td>
</tr>
<tr>
<td>Conversational learning</td>
<td>Learning is in terms of conversations between different systems of knowledge (Sharples, 2002).</td>
<td>Interaction and communication dependent mobile learning</td>
<td>Laboratory classes, Field trip, Mobile computer supported collaborative learning Calling, Interactive Voice Respond (IVR)</td>
</tr>
</tbody>
</table>

- Social context
- Communication between peers via mobile phones.
<table>
<thead>
<tr>
<th>Learning</th>
<th>Lifelong information and interaction with education content in mobile learning</th>
<th>Social networks (Blogs, Wikipedia, Twitter, Youtube)</th>
<th>Podcast</th>
<th>E-mail</th>
<th>Mobile Forums</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifelong learning</td>
<td>Learning happens all the time and is influenced both by our environment and the particular situations we are faced with (Sharples, 2000).</td>
<td>Information resources Mobile web site</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Informal learning</td>
<td>Learning is a process of learning that occurs autonomously and casually without being tied to highly directive curricula or Instruction (Vavoula, 2004)</td>
<td>Information and interaction with education content in informal mobile learning setting Mobile information resources Mobiles in a museum setting Field Trips Science Field Work</td>
<td>Social networks (Blogs, Wikipedia, Twitter, Youtube) Podcast E-mail Mobile Forums</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity theory</td>
<td>Learning occurs with three features-involving a subject (the learners), an object (the task or activity) and tool or mediating artefacts and human behaviour is situated within a social context that influences their actions (Vygotsky, 1987).</td>
<td>User actions in social context dependent mobile learning Actively participation Social context Activities</td>
<td>Museum Art Gallery exhibit via SMS, polls, calling Mobile Games Multimedia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connectivism</td>
<td>Learning is process of connecting specialized nodes or information sources (Siemens, 2004).</td>
<td>Diversity of information sources in mobile learning Connecting specialized nodes Information sources Facilitate continual learning environment Knowledge management activities Decision-making</td>
<td>Social networks (Blogs, Wikipedia, Twitter, Youtube) Podcast E-mail Mobile Forums Discussion Platforms Podcasting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Navigationism</td>
<td>Learning is a process of connecting specialized nodes or information sources (Brown, 2005).</td>
<td>Complex of information sources in mobile learning Connecting specialized nodes Information sources Facilitate continual learning environment Knowledge management activities Decision-making Manage information (identify, analyse, organize, classify, assess, evaluate, etc.) Sense making and chaos management.</td>
<td>Social networks (Blogs, Wikipedia, Twitter, Youtube) Podcast E-mail Mobile Forums Discussion Platforms Podcasting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location based Learning</td>
<td>Location-based learning holds promise for just-in-time learning tied to a student’s physical location (Johnson et all, 2009)</td>
<td>Location context in mobile learning Conceptual knowledge Conceptual application Constructive environment Partnership with location Immersive activities</td>
<td>Field trips Archaeology studies Location based game Virtual world Google Map, GPS, RFID, network triangulation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Current Mobile Learning Practices
In this part, it will be given some current mobile learning applications developed by METIL LAB (Mixed Emerging Technology Integration Lab) in the Institute for Simulation & Training in University of Central Florida which is a world-leading center for the development, demonstration, and utilization of interactive and virtual systems for simulating operational environments and for training personnel who will utilize specific
equipment and systems in those environments. METIL produces mobile learning application and provides mobile learning research and development expertise for the public, private, and social sectors.

- **Johnson & Johnson**
  The Johnson & Johnson PRD 3D University is a virtual world onboarding system for Johnson & Johnson, allowing constant new employee training and orientation from all locations worldwide while fostering communication among the employee base. Employees can launch corporate learning materials and exercises, get help from HR personnel and collaborate with colleagues across the globe. METIL continues to provide consultation and development services for PRD 3D University, along with mobile, simulations, and Web 2.0 techniques and products to help connect and streamline processes for Johnson & Johnson's global workforce.

- **Microsoft Mobile Course and IVR Sales Materials**
  As smart phones become more common and mobile web browsing improves, the need for mobile access to learning and training materials is more in demand and has greater impact for business professionals. METIL took Microsoft's existing web courses and created a SCORM-compliant mobile web template. This allows the content from Microsoft's web courses to be easily repurposed (requiring only some modifications to media assets) for mobile access with full progress tracking and scoring.

  Sales professionals in particular have a strong need for on-demand, mobile access to refresher materials on their product line. Driving, however, provides challenges to many methods of delivering mobile content, such as apps or mobile web access, due to limiting ability to look at the device's screen; this is especially true now due to stricter hands-free laws in many states. In order to allow simple, hands-free access to sales data, we developed a voice recognition IVR (Interactive Voice Response) system that allows sales professionals to navigate Microsoft's product information library and select audio for listening.

- **My Sports Pulse**
  The My Sports Pulse project combines mobile and web technologies, STEM education, and a sports theme to create an innovative approach to bolstering understanding and interest in science and mathematics fields. Students can register with the My Sports Pulse program to receive questions, presented within the context of sports scenarios, about subjects such as physics, nutrition, algebra or geometry. Questions are delivered through
text messages or email, and can also be accessed and answered directly through the My Sports Pulse website. As students answer questions, they earn points in various knowledge areas and build up their own avatar to compete with other students and schools. The My Sports Pulse program has been piloted with several schools inside and outside of the US, with promising results.

![My Sports Pulse](image1.png)

**Figure 3- My Sports Pulse Project**

- **Dream Corp Alternate Reality Game**
  Run as a demonstration for Elliot Masie’s Learning 2008 conference, the DreamCorp Alternate Reality Game (ARG) provided an introduction to cross-media training and employee onboarding. The game involved several challenges on three different tracks: Compliance, Leadership and Flexible Workforce. Players took on the role of employees at fictional company DreamCorp and worked, sometimes alone and sometimes in cooperation with fellow players, to solve puzzles and complete the assigned challenges. Portions of the game were offered through multiple avenues and media formats: printed materials (e.g. pamphlets and newsletters), emails, text messages, in-person interaction with METIL team members acting as DreamCorp employees, and a bonus task offered in Second Life.

- **Go for the Green**
  Go for the Green is a mobile web game, developed for The Willis Organization, that uses a golf theme to reinforce key sales concepts. Nine holes of the golf course are mapped to nine steps in the sales process, with each hole presenting several questions and feedback items related to that particular step. Users attempt to complete the full course by answering all questions and avoiding common "traps" in the sales process. By using streamlined mobile web development rather than creating a specific game application, we are able to deliver this content to a wide range of user devices including iPhone, Blackberry and various Symbian and Windows Mobile platforms.

![Go for the Green](image2.png)

**Figure 4- Go for the Green**

CONCLUSION

Mobile learning has a promising future as a field of study. In related literature, there are many different approaches, theories and practices. The current m-learning study field will be more understandable for new researchers if these definitions, approaches and theories are discussed and linked to concrete mobile learning practices.
REFERENCES


THE DESIGN AND DEVELOPMENT OF A SEMI-AUTO COMPUTER GENERATED TESTING PAPER SYSTEM — A CASE STUDY IN THE SCHOOL OF CONTINUING EDUCATION AT CHINA UNIVERSITY OF GEOSCIENCES

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ABSTRACT
With the rapidly increasing entrance examinations for the School of Continuing education of CUGB, there is an urgent need of the examination papers that have the parallel testing ability for the same academic program. Based on the analysis of parallel factors and the comparison of the manual generated mode and the computer generated mode, the most time-consuming and experience-consuming steps are found. By providing supports to those steps automatically, a semi-auto computer generated testing paper system was designed and developed for reducing the workload of the experienced faculties to generate testing papers. The papers were generated based on a gradually constructed item-bank. The system offered multiple templates of the testing paper structure plan for assisting semi-auto paper generated procedure and guaranteeing the parallel of the generated papers. In order to construct an item-bank in a short time, an easy-to-use authoring tool with powerful functions was designed and developed. The system supported the spring entrance examination of SCECUGB in 2010 successfully. Faculties gave positive feedback toward the system.

Keywords: semi-auto computer generated testing paper, item-bank, manual generated testing paper, test assembly

INTRODUCTION
As a pilot distance education school in China, the School of Continuing Education at China University of Geosciences in Beijing (SCECUGB) recruits students twice a year nationally. A batch of web-based distance education schools set up in recent years aggravated the recruit competition of distance education. SCECUGB has to expand the scope of enrollment. Gradually, part-time students instead of full-time ones become the main target recruit groups. The target recruit groups require to be enrolled at any time instead of the fixed time. SCECUGB has been forced to shorten the interval and increase the times of the entrance examinations. A national examination requires a set of parallel testing papers (Hwang, Chu and Yin 2008). The greatly increasing entrance examination requires a large amount of parallel testing papers for the same academic program. Paper generation is a time-consuming and resource-consuming work. It is impossible to generate those rapidly increasing papers manually as before because of the relative shortage of experienced faculty members.

As the result, computer generated paper system can solve the problem stated above for its convenient, safe and economic functions. However, those working systems have a common feature that a mature testing item-bank is associated. Unfortunately, there is not an item-bank of this kind in the case of SCECUGB. In this study, based on the analysis of parallel manual paper generation procedure and common computer paper generation procedure, the most time-consuming and experience-consuming steps are found. Consequently, by providing support to those steps, an altered semi-auto computer paper generation procedure is proposed. Based on this altered procedure, a semi-auto computer generated testing paper system is designed and developed, trying to provide supports assisting paper generation.

In order to provide sufficient supports for faculties alleviating their heavy work load, following issues should be solved in this paper.
(1) How to generate parallel papers?
Finding the most time-consuming steps and trying to finish it automatically.
(2) What is the most time-consuming step in the paper generation procedure?
Analysis in the manual paper generated procedure reveals that to construct Two-Way Charts indicting the paper structure plan is the most time-consuming and experience-consuming task.
(3) How to provide sufficient support for paper generation?
Based on embedded template paper structure plans and automatically generated paper structure plans, item selection in the computer generated mode and item compiling in the manual generated mode are simplified and greatly supported.

LITERATURE REVIEW

Computer generated testing paper system is a subsystem of a Computer Based Testing(CBT) System. Computerized tests are classified into two categories in the literature (e.g. Lilley, 2004; López-Cuadrado, Pérez, Vadillo and Gutiérrez, 2010): computer-based tests (CBTs) and computerized adaptive tests (CATs). The former ones are computerized fixed form tests which are similar to pen-and-pencil tests.

No matter based on CBTs or CATs, researches on the computer generated testing paper system usually focus on the algorithm optimization to achieve the fast and precise retrieval (Feng, 2010; Yu, 2008; Yuan, 2008; Hwang, Lin and Lin, 2006; Chou, 2000).

When a system is based on a gradually constructed item-bank, the algorithm optimization is not the key point. The main considerations to construct such systems should be the parallel generation of the testing papers in different entrance examinations for the same academic program, the procedure of paper generating, and the assistance for faculties to generate the papers efficiently.

Parallel Generation

The widespread use of computerized testing is blocked by following factors: (1) limited technological capacity (e.g. accessing computer and internet) to support computerized testing in some testing centers sometimes (Thurlow, Lazarus, Albus and Hodgson, 2010), (2) candidates short of computer skills (3) inconvenience in answering items of some types (e.g. calculation questions in Mathematics) in computer. Accordingly, computerized testing and pen-and-pencil testing are carried out in parallel. Therefore, generated papers are all fixed testing papers, the same as pen-and-pencil trials. Thence, papers should not only be parallel in content but also should be parallel in form.

Parallel in form. The form of the testing papers in different entrance examinations for the same academic program should be paralleled in order to avoid the interference of themselves to the test results (Ma and Ding, 2006). The parallel form means the same item quantity, fixed testing time and the same structure: consisting of a set of ordered sections grouped by item-type.

Parallel in content. The content of the testing papers should also be parallel. According to the knowledge structure of the exam requirement (Fig 1), the proportion and the difficulty of testing items related to each part of the knowledge are set equally in different testing papers. For example, Fig 1 is a knowledge structure for the exam of Advanced Mathematics, which includes three layers. In layer 1, the proportions of knowledge components are described. In layer 2, the acknowledge components are divided into smaller pieces. In layer 3, all the knowledge pieces are shown as basic testing units with testing objectives. Zhao, Wang and Zhao (2010) described the standard of the content parallel in different papers. In layer 1, the testing items related to the knowledge components should be equal proportion. In layer 2, the testing items should cover 80% of the knowledge pieces. In layer 3, the testing items related to the basic testing units should be selected randomly, and the difficulty level should be matched with the testing objectives.

![Figure 1. Knowledge Structure of the Advanced Mathematics](image-url)
Manual Generated vs. Computer Generated

Manual Generated Procedure. Liu (2006) described the manual generated procedure (Fig 2). Faculties of SCECUGB confirmed the procedure. Besides, they specified the steps in the procedure (Fig 3). Firstly, analyzing the exam requirement and determining the purpose of testing. And then secondly, specifying it into a group of Two-Way Charts indicating the paper structure plan (Table 1, 2). Thirdly, compiling the items and filling them into each type section according to the Two-Way Charts. Finally, checking the paper and its parallelism with other papers used in the same program, and jumping back to step 3 to revise the paper. The entire procedure is very complicated and time consuming, because the factors of item-type distribution, knowledge-component distribution, and difficulty distribution should be considered synthetically. Step 2 is recognized as the most tough and time-consuming step by faculties. Even faculties with the richest paper-generation experiences have to revise the paper structure plan constantly in order to achieve the final balance. After the paper structure is determined, the compilation and filling of the items become relatively simple.

Computer Generated Mode. Fig 4 shows a Two-Way Chart based computer paper generated procedure, which is similar to manual paper generated procedure and all steps are adopted from “basic steps in classroom testing” proposed by Gronlund and Linn (1990). However, paper generated procedures in most systems do not support Two-Way Chart (Wang, 2008). Therefore, the procedure is revised and the computer paper generated mode is showed in Fig 5.

Contrast to the manual mode, in computer generated mode (Fig 5), the procedure is composed by only 3 steps. Step 1 is the same as that in manual mode. While step 2 is completely different, the paper structure plan is specified automatically based on the parameters input in manual. But the plan is simpler than that in manual mode. In the selection process (step 3), item searching and filling in, paper structure plan revising and paper checking & revising are intertwined. Therefore, in the computer mode, partial paper structure planning process (the parts marked by * in Fig 3) and the whole checking and revising process are shifted into the item selection process.

In computer generated mode, selection algorithm optimization is emphasized. The purpose of the algorithm optimization is to increase the precision and the speed of item selection with some initial conditions given. If there are sufficient amount of testing items in the item-bank, under the aid of appropriate selection algorithm, papers fitting the requirement can be generated fast and easily.

This mode highlights following advantages. 1) simple input 2) fast speed 3) precision

Step 1: Determining the purpose of testing
Step 2: Constructing the paper structure planning (Two-Way Chart)
Step 3: Compiling and filling items according Two-Way Chart
Step 4: Checking and Revising

Figure 2. The General Manual Generated Procedure (Liu, 2006)

Step 1: Determining the purpose of testing
(1) Specifying knowledge structure
(2) Setting the proportion of knowledge components in layer 1
(3) Defining testing objective of each basic unit in layer 3

Step 2: Constructing the paper structure planning (Two-Way Charts)(manual)
(1) Specifying type plan: scores, testing time and item’s quantity of each type (see Table 1)
(2) Specifying item type assignment according to difficulty level (see Table 1)
(3) Specifying item type assignment according to knowledge (concept) components (see Table 2)

Step 3: Compiling and filling items according Two-Way Charts(manual)

Step 4: Checking and Revising (manual)
(1) Checking papers
(2) Checking parallel of the papers with the others
(3) Returning the above steps

Note: this procedure is extracted from interview with faculties of SCECUGB.

Figure 3. The Procedure of Manual Generated Mode (extracted from the interview with faculties of CUGB)
### Table 1: Two-Way Chart Indicating Type Plan

<table>
<thead>
<tr>
<th>Item type</th>
<th>Multiple Choice</th>
<th>Fill-in Blank</th>
<th>True/False</th>
<th>Calculation</th>
<th>Integrated Question</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item quantity</td>
<td>15</td>
<td>20</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>46</td>
</tr>
<tr>
<td>score</td>
<td>1(per item)</td>
<td>2(per item)</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Testing time (minutes)</td>
<td>15</td>
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<td></td>
<td></td>
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<tr>
<td>Difficulty</td>
<td>A 8</td>
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<td></td>
<td>B 7</td>
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<td>D</td>
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<tr>
<td>Testing Objectives</td>
<td>I 8AI</td>
<td>5AI</td>
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<tr>
<td></td>
<td>II 1AI</td>
<td>7BII</td>
<td>1CII</td>
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</table>

Note: Difficulty : A. Easy, B. Medium, C. Difficult, D. Very Difficult

Testing Objectives: Bloom’s taxonomy, I Remembering, II Understanding, III Applying, IV Analyzing (Anderson et al., 2001)

### Table 2: Two-Way Chart indicating Item Type Assignment according to Knowledge Components

| Concept 1 | Multiple Choice | 3 | 3 | 3 | 9 |
| Concept 2 | Fill-in Blank   | 4 | 4 | 4 | 8 |
| Concept 3 | True/False      | 4 | 4 | 8 |
| Concept 4 |                | 4 | 8 |
| Concept 5 |                | 4 | 8 |
| Concept 6 |                | 4 | 8 |
| Concept 7 |                | 4 | 8 |
| Concept 8 |                | 4 | 8 |

Note: *Bloom’s taxonomy of cognitive domain (Anderson et al., 2001)

---

Step 1: Determining the purpose of testing
Step 2: Constructing the two-way chart
Step 3: Selecting appropriate items according to the Two-Way Chart
Step 4: Preparing relevant items
Step 5: Assembling the test

Figure 4. The Computer Generated Procedure (Gronlund et al., 1990)

Step 1: Determining the purpose of testing
(1) Specifying knowledge structure
(2) Setting the proportion of knowledge components in layer 1
(3) Defining testing objective of each basic unit in layer 3
Step 2: Constructing the paper structure planning (semi-automatic)
(1) Specifying the general type plan: scores, testing time and item’s quantity of each type (manual)
(2) Constructing the paper structure planning (see Table 1) (automatic)
Step 3: Selecting appropriate items according to the criteria inputted in step 2 (automatic)
(1) Searching and filling in the items
(2) Revising the paper structure plan
   . Type and item assignment according to knowledge components*
   . Type and item assignment according to difficulty level*
(3) Checking and revising
Note: * task belonging to the paper structure planning process in the manual generation mode

THE DESIGN OF A SEMI-AUTO COMPUTER GENERATED TESTING PAPER SYSTEM

The Semi-Auto Computer Generated Mode
In the case of SCECUGB, there is no mature item-bank. In order to continue the automatic generation procedure when short of items, a new mode, other than manual and automatic computer generated ones, is designed and developed in this study. It is called Semi-Auto Computer Generated mode. In this mode, the procedure is more similar to manual mode, while most of the steps are processed automatically just like those in computer generated mode.

In this mode (Fig 6), step 1 is the same as that in manual mode and computer generated mode. In step 2, the first executed three tasks of the paper structure planning are the same as those in the manual mode, and the forth task, assigning items of different types to knowledge components (see Table 3), is newly added in the paper structure plan. All the four tasks are computer generated automatically based on the exam requirement analysis. In item selection step(step 3), if short of the items, semi-auto mode starts to work and the procedure jumps to step 4. In step 4, the system requires the faculties to compile and fill in the items according to the specific criteria manually. Otherwise, the item compiling and filling in are executed automatically, which are the same as that in the computer mode.

This mode highlights two advantages obviously. 1) With the separation of the item selection and paper structure planning, the process of paper generation could continue when short of items. 2) Computer finished most of the time consuming tasks (constructing the paper structure planning) in the manual mode.

Step 1: Determining the purpose of testing
(1) Specifying knowledge structure
(2) Setting the proportion of knowledge components in layer 1
(3) Defining testing objective of each basic unit in layer 3
Step 2: Constructing the paper structure planning (automatic)
(1) Specifying Type plan: scores, testing time and item’s quantity of each type (see Table 1)
(2) Specifying Item type assignment according to difficulty level (see Table 1)
(3) Specifying Item type assignment according to knowledge components (see Table 2)
(4) Specifying Assigning items of different types to knowledge components *
Step 3: Selecting appropriate items according to the Two-Way Chart (automatic)
Step 4. Items compiling & filling in (manual) **
Step 5. Checking & revising (automatic)

Note: * task added in the mode
** step can be omitted if item selection is successful

Table 3: Assignment of Items to Knowledge Components in the Paper Structure Plan
The Construction of the Item-Bank

The construction of an item-bank includes three databases: knowledge structure, paper structure plan, and testing items.

1. The database of the knowledge structure. The knowledge structure (see Fig 1) described based on the exam requirement is recorded in the database. The description of the proportion of the knowledge components in layer 1 is recorded as well. Also, the description of the testing objective of each basic unit in layer 3 is recorded.

2. The database of paper structure plan. In the database, paper structure plans (see Table 1,2) are recorded, the fields of which include testing time, difficulty level, item type proportion, knowledge component proportion of each item type, difficulty level of each item type, as well as assignment of items of different types to knowledge components (Table 3). The templates of the plans are defaulted based on the previous manually generated papers.

3. The database of the testing items. The metadata and the entities of the testing items are recorded in the database. The metadata is defined by China E-Learning Technology Standardization Committee [CELTSC] (2003) in the Technical Specification for Educational Resource Construction Information Model (CELT-41.1 CD1.0, 2003). It includes manually input attributes (such as, item type, difficulty, discrimination, exam requirement, criterion, score, secrecy) and self-generated attributes (such as, modified difficulty, modified discrimination, used time, exposal date). Item attributes are used to aid the item selection. If an item covered two or more knowledge units, the ratio should be indicated. Therefore, items in the database are connected and organized based upon the knowledge structure quantitatively.

Item Authoring and Storage

Item-bank of SCECUGB is gradually built. An authoring tool is designed to support the faculties to do testing items editing including formula editing and text-graphics integration. The authoring tool is developed based on the comparison of three technical solutions (Table 4). Finally, the solution of plug-in based on MS Word is chosen, because it can provide powerful functions with user-familiar interface and requires less work load to develop. The authoring tool developed based on the solution is called TheolEditor.

Table 4: The Developing Solutions of the Authoring Tools

<table>
<thead>
<tr>
<th>Solution</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
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<tbody>
<tr>
<td>Authoring tool based on web browser</td>
<td>No plug-ins installation required</td>
<td>Hard to develop, poor performance in text-graphics integration</td>
</tr>
<tr>
<td>Client authoring tool</td>
<td>Self-developed plug-in</td>
<td>Text-graphics integration supported</td>
</tr>
<tr>
<td>A plug-in based on MS Word</td>
<td>High performance in functions, user-familiar interface</td>
<td>Installation required</td>
</tr>
</tbody>
</table>

Figure 7 shows the process of the editing testing items. With the help of Browser-Helper-Object (BHO, browser Interactive interface opened for third-party programmers), TheolEditor will be started while web browser tries to access some specific URL. Next, TheolEditor invokes the client-installed MS Word to edit an item file. Then,
TheolEditor saves the edited file and exit MS Word. The file is saved into two copies, one as doc format used for further editing, and the other as html format used for viewing. Finally, TheolEditor uploaded the files to the server.

TheolEditor supported batch-input of items by tagging specific defined symbols on the items in the Word. All the items with title, question, answer and metadata are tagged separately. TheolEditor identifies and extracts the metadata and entities of the items from the Word file, and save them into the item-bank.

**Figure 7. TheolEditor Editing Items Process (Guan, Han, Zhou and Shen, 2008)**

### Generation and Utilization of the Paper Structure Plan

1. **Generation of the Template Paper Structure Plan**

   Some paper structure plans are recorded as templates in the item-bank. These template plans are reverse-generated automatically from the testing papers which either are compiled manually, or computer generated in the past entrance examinations. Every paper structure plan is composed by two multidimensional Two-Way Charts (Table 1, 2). Figure 8 shows the automatic reverse-generation procedure: the corresponding relationships between items of different types and knowledge components (Table 3) are extracted from the papers, and then the elements of a paper structure plan (Table 1, 2) are generated based on the relationships, which includes testing time, difficulty level, item type proportion, knowledge component proportion of each item type and difficulty level of each item type. The parallel in form and content of the templates are checked automatically based on the exam requirement analysis.

2. **Generation of the Paper Structure Plan**

   Besides of those template paper structure plans, the system also supports automatic paper structure plan generation. The procedure is in the following sequence:

   **Step 1.** Specifying the general type plan: scores, testing time and item’s quantity of each type (in manual).

   **Step 2.** Specifying the item type assignment according to knowledge (concept) components (Table 2), conforming to the knowledge allocation defined in the examination requirements. Specifying the detailed item-knowledge assignment.

   This step is composed by following sub-steps:

   - **Step2.1** Sorting the item type according to the average knowledge component amount from highest to lowest.
   - **Step2.2** Picking the highest agreement item type, (e.g. Integrated Question, in Advanced Mathematics).
   - **Step2.3** Picking a set of knowledge components of an integrated question within the range in the database (the knowledge components of some item type are usually fixed) at random. The choice is recorded as the knowledge components of the first Integrated Question.
   - **Step2.4** Picking another set of knowledge components.

**Figure 8. Reverse-generation Procedure of the Templates for Paper Structure Plan**
Step 2.5 Checking whether this choice would overlap the knowledge components chosen in the former steps too much, that is, if the majority of knowledge components would be overlap with chosen knowledge components previously. If it is so, discarding this set and going back to Step 2.4 to pick another set of knowledge components, but ensuring that all the discarding knowledge components would not be selected again.

Step 2.6 Assigning the set of knowledge components chosen above to the next testing item.

Step 2.7 Continuing Step 2.4-2.6 until knowledge components assignment for all testing items of the select item type is finished.

Step 2.8 Pick the next item type.

Step 2.9 If every item of this type usually consists two or more knowledge components, continuing Step 2.4-2.7.

Step 2.10 Pick all the item types, items of which covering only one knowledge unit.

Step 2.11 Assigning knowledge unit to rest items with according to the examination requirement analysis.

In this way, the detailed item-knowledge assignment and item type assignment according to knowledge components are set.

**Step 3.** Specifying the item type assignment according to difficulty level and testing objectives(see Table 1)

(3) Utilization of the paper structure plan

The paper structure plans work as the blueprint of testing paper, greatly assisting the paper generation procedure. In the computer generated mode, the selection criteria transferred from those detailed knowledge components of every item accelerates item selection.

In the manual generated mode when short of items, the system not only provides the detailed knowledge components as item compiling rule, but also provides sample testing items consisting similar knowledge components to faculties for reference.

**THE APPLICATION IN THE SCHOOL OF CONTINUING EDUCATION AT CUGB**

After the installation of the semi-auto computer generated paper system in SCECUGB, items were collected and imported into the database. The post-test review showed that faculties were satisfied with the authoring tool for its seamless integration with MS Word.

After a month, in the spring entrance examination in the distance examination center located in Luohe City, Henan province, the system was put into service. The item-bank with no more than 100 items successfully supported the paper generating procedure. Experienced faculties showed positive attitude toward using this system.

**CONCLUSION**

In order to alleviate faculties’ heavy work load in paper generation, automatic computer generated system is proposed as the solution. However, the shortage of a mature item-bank makes the common generation systems unsuitable. Based on the analysis and comparison of manual paper generated mode and computer automatically paper generated mode, in the paper generation procedure a semi-auto system is accordingly designed and developed. By providing strong support to the most time-consuming step, constructing paper structure plan, the system supports the paper generation greatly. The system not only provides template paper structure plan and also supports the automatic generation of new paper structure plan.

This system worked well in the situation of the short of testing items in the item-bank. The system provides a powerful authoring tool for editing items assisting the item-bank construction. In real entrance exam condition, this system was tested and has obtained a positive result.

**REFERENCES**


THE EFFECTS OF INSTRUCTION WITH VISUAL MATERIALS ON THE DEVELOPMENT OF PRESERVICE ELEMENTARY TEACHERS’ KNOWLEDGE AND ATTITUDE TOWARDS GLOBAL WARMING

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ABSTRACT
This study aimed to identify the erroneous knowledge and misconceptions of preservice elementary teachers about global warming and examine the effects of instruction with visual materials on rectifying these misconceptions and fostering a positive attitude towards the issue of global warming. Having a quasi-experimental design, the study made use of both quantitative and qualitative research methods. The participants of the study, which was conducted in 2008-2009 academic year in Giresun University’s Education Faculty, were 47 preservice elementary teachers. Data were obtained by using open ended questions, the Global Warming Attitude Scale (GWAS) and semi-structured interview forms. The results showed that both experimental and control group individuals had knowledge gaps and certain misconceptions about the reasons underlying global warming. However, preservice teachers were more successful in rectifying the gaps and misconceptions via instruction with visual materials. After the intervention, the experimental group had higher global warming attitude scores. However, no meaningful relationship existed between the groups with respect to their attitude scores.

Keywords: Global warming, visual materials, preservice teachers.

INTRODUCTION
Increased fossil fuel consumption in the developed and developing world results in the emission of hazardous gases into the atmosphere. Led by $H_2O$ (water vapor), $CO_2$ and $CH_4$, these gases prevent radiation reflected from the earth from leaving the atmosphere and cause a greenhouse effect (IPPC, 2007). This causes gradual warming of the earth and is known as global warming. Caused by humans (scientific, political, economic and ethical fields) and resulting in climate change, global warming is the most serious environmental problem in the 21st century (Schreiner, Henriksen & Hansen, 2005). However, the effects of global warming are not limited to the countries that cause extensive emission of these gases. In the near past, powerful natural phenomena have occurred in many lands ranging from America to Europe, and from Asia to Antarctica. The increase in the number and intensity of hurricanes and typhoons in America and Japan, the rapid melting of polar ice, floods in the south of Asia, the unexpected damage caused by forest fires in Australia have led to thousands of casualties as well as billions of dollars in financial loss (Lynas, 2008). Faced with such destruction, joint movement of countries has become a necessity. Though they have been working to reduce emissions (Vienna Convention in 1985, Montreal Protocol in 1987, Rio Declaration in 1992, Kyoto Protocol in 1997, Buenos Aires Climate Summit in 1998, Marrakesh Agreement in 2001, Bali Climate Change Conference in 2007, and Ponzan Climate Conference in 2008, etc.), the lack of a strong collaboration, as was the case in ozone depletion, means that the increasing emission of these gases continues.

As much as the solution of environmental problems such as global warming relies on political, economic and technological remedies, it also requires more educated individuals who know about environmental problems and the measures needed to rectify them. As the future of our planet is in the hands of today’s children, the “environmental education investment” to be made in children is an investment made in our planet (Atasoy & Ertürk, 2008; Bozkurt & Cansüngü, 2002; Yılmaz, Morgil, Aktug & Göbekli, 2002). Parallel to curriculum revision studies elsewhere in the world, various adjustments have been made in environmental education curricula in Turkey too. Environmental education started to be offered within the scope of formal education after 1991 (Erol & Gezer, 2006), was integrated into the science curriculum in 1993 (Demiröven, 1999), and its concepts became emphasized even more with the new science and technology curriculum that has been in effect since 2004 (Yılmaz, Tuncer & Aydemir, 2008). At the same time, global environmental problems were given a place in the elementary school science and technology curriculum in 2005-2006 academic year (Oluak & Ózalp, 2007). Additionally the Turkish Ministry of Education published a circular letter in 2007-2008 academic year (dated 28.08.2007, article 7997, Global Warming Circular Letter 2007/66), which for the first time would be used as a guide in educating elementary and junior high school students about the precautions they should take for diminishing global warming. To do this, various visual materials were utilized. Besides, some schools arranged various environmentally friendly activities such as planting trees, photograph exhibitions, poetry, painting and project competitions (MEB, 2009).
Environmental Education and Teachers’ Role
According to National Science Education Standards, elementary school pupils should be aware of various natural phenomena. Therefore, teachers must equip students with these phenomena in the classroom and eliminate their misconceptions (Khalid, 2001). Previous studies have pointed out that instructional strategies and methods have a very important role in the elimination of misconceptions and the teaching of environment-related knowledge, attitudes and values (DiEnno & Hilton, 2005) and that student-centered strategies are needed rather than traditional instructional strategies (Demirkaya, 2009; Pekel, 2005; Andersson & Wallin, 2000; Kapyla & Wahlstrom, 2000). For instance, it has been pointed out that ensuring active student participation in all activities ( Sağır, Aslan & Cansaran, 2008), giving them an opportunity to work in small collaborative groups (Andersson & Wallin, 2000), conducting related laboratory activities and field trips (Bozkurt & Cansıngı, 2002) and introducing environmental problems through effective materials that trigger student curiosity and attract their attention (activities, diagrams, overhead projector, slide shows, etc.) (Darçın, Bozkurt, Hamalosmanoğlu & Köse, 2006; Lestera, Maa, Lea & Lambert, 2006) may have positive effects on developing knowledge, attitudes and behaviors related to environmental problems. However, well-equipped teachers are needed to fulfill these tasks (Moseley, Reinke & Bookout, 2002). Therefore, teachers need training in the first place so that student awareness can be raised about environmental problems (Hillman, Stanisstreet & Boyes, 1996). Otherwise, students will end up with the same deficient information or misconceptions about environmental problems. It is thus important to identify and rectify preservice teachers’ misconceptions (Pekel, 2005; Khalid, 2003).

Research about GW in Education
Previous studies have shown that very few preservice teachers have an adequate level of information about environmental problems such as global warming, greenhouse effect, ozone layer depletion, and acid rain (Soran, Morgil, Yücel, Atav & İşik, 2000; Bahar & Aydın, 2002; Yılmaz, Morgil, Aktug & Göbekli, 2002; Erol, 2005; Pe’er, Goldman & Yavetz, 2007; Matkins & Bell, 2007; Desjean-Perrotta, Moseley, & Cantu, 2008; Demirkaya, 2008; Yılmaz, Tuncer & Aydemir 2008; Öztas & Kahpçı, 2009; Bozdoğan, 2009b). Another noteworthy finding has been that preservice teachers have similar misconceptions. The most common misconception is to believe that there is a relationship between ozone layer depletion and global warming or greenhouse effect (Boyes & Stanisstreet, 1992; Read, Bostrom, Morgan, Fischhoff, & Smuts, 1994; Dove, 1996; Summers, Kruger, Childs & Mant, 2001; Khalid, 2001, 2003; Pekel, 2005; Michail, Stamou & Stamou, 2007; Matkins & Bell, 2007, Bozdoğan, 2009b). Other misconceptions include believing that using unleaded petrol decreases global warming (Boyes & Stanisstreet, 1992); exhaust gases deplete the ozone layer (Hillman, Stanisstreet & Boyes, 1996); greenhouse effect results from radioactive waste, acid rain and ozone layer depletion (Groves & Pugh, 1999); greenhouse effect causes skin cancer (Groves & Pugh, 1999; Khalid, 2001) and earthquakes (Groves & Pugh, 1999); and greenhouse effect results from CO₂ cycle failure (Bahar & Aydın, 2002).

At the face of global warming, preservice teachers were more knowledgeable about environmentally-friendly behaviors such as decreasing fossil fuel consumption, planting trees, using recycled products (Groves & Pugh, 1999; Yılmaz, Morgil, Aktug & Göbekli, 2002). On the other hand, despite their limited environmental knowledge, preservice teachers were found to know the importance of environmental education and have positive attitudes towards the environment (Lane, Wilke, Champeau & Sivek, 1994; Pe’er, Goldman & Yavetz, 2007). It has been shown through research that female students were generally more sensitive about environmental problems than male students and develop more positive attitudes (Şama, 1997; Erol & Gezer, 2006).

Considering that preservice teachers state print and visual media as their main source of information (Hillman, Stanisstreet & Boyes, 1996; Groves & Pugh, 1999; Khalid, 2001; Yılmaz, Morgil, Aktug & Göbekli, 2002; Pe’er, Goldman & Yavetz, 2007; Öztas & Kahpçı, 2009; Hansen, 2009), the media has been blamed for these misconceptions (Hillman, Stanisstreet & Boyes, 1996; Khalid, 2001; Oluk & Özalp, 2007).

It has been suggested that in order to rectify the misconceptions, the curriculum of teacher education institutions should be revised (Mckeown-Ice, 2000) and both field and and pedagogical knowledge and practice should be offered with the help of experts (Lane, Wilke, Champeau & Sivek, 1994; Summers, Kruger, Childs & Mant, 2001; Moseley & Utley, 2008; Kostova & Atasoy, 2008). Considering that traditional instructional methods may not be effective in teaching these problems (Pawlik, 1991), new methods and techniques where students are active should be used (Moseley, Reinke & Bookout, 2002; Paul & Volk, 2002; Oluk & Özalp, 2007) and interactive activities in laboratory and field work should be conducted (Pruneau et. al., 2006; Matkins & Bell, 2007; Moseley & Utley, 2008). Previous studies have shown that teachers and preservice teachers did not know about the instructional strategies that may be used in the environmental education course and therefore needed help (Lane, Wilke, Champeau & Sivek, 1994; Moseley & Utley, 2008). In addition, experimental or quasi-experimental studies have shown that workshop studies on teaching environmental problems have positive effects on teachers (Paul & Volk, 2002), extracurricular activities increased preservice teachers’ self-competencies in presenting...
environmental problems in the classroom (Moseley, Reinke & Bookout, 2002), and various environmental education programs developed preservice teachers’ awareness of and attitudes towards environmental problems (Pruneau et al. 2006). In addition to these, it has been documented that methods and techniques such as problem solving, field trip, laboratory work and modeling bring better outcomes than teacher-centered instruction in environmental education (Kostova & Atasoy, 2008; Doğru, 2008). Last but not least, it has been suggested that teacher education programs are generally not sufficient in environmental education and that preservice teachers who are to teach environmental education do not have a systematic information flow (Mckeown-Ice, 2000; Yılmaz, Morgil, Aktug & Göbekli, 2002).

**Visual Materials and Education**

Visual instructional materials include graphics, photographs, concept maps, Powerpoint presentations, films, computer and television images, etc. (Düzgün, 2000). Films are powerful visual tools that may visually present different places and events, offer unrivalled experiences, and facilitate learning (Norman, 2000). Another visual material, pictures and photographs are tools that make learning fun, motivate students to learn and enrich their imagination (Werff, 2003; Wright, 1989). DenBeste (2003) states that visual resources such as pictures and videos help the visualization of various situations in the classroom. He also adds that visual materials support written texts in all disciplines. Another visual material, Powerpoint presentations are also an ideal tool for course presentation. They allow teachers to collect important information in one single file and then present it. These interesting presentations teach them key concepts in particular, increase their attention in the lesson (Szabo & Hastings, 2000; James, Burke & Hutchins, 2006; Burke & James, 2008) and help them learn complex information in depth (Adams, 2006). They are also effective materials in offering students summary information about the topic (Butler & Mautz, 1996). Previous studies also show that courses taught via Powerpoint presentations yield better cognitive outcomes in students than traditional instructional methods (Butler & Mautz, 1996; Christine, 1998; Lowry, 1999; Sugahara & Boland, 2006; Cramer, Collins, Snider, & Fawcett, 2007). Another important feature of Powerpoint presentations is that it is easy to place them within various visual materials to be used in instruction (Bouchlaghem, Wilson, Beacham & Sher, 2002). However, the following points need to be considered when preparing Powerpoint slides (Burke, Ahmadi & James, 2009):

1. Color contrast needs to be adjusted so that the background is easy to see (For instance, dark font colors used against a light background color may be read with more ease).
2. There should not be too many colors in the slides (three different colors are usually enough; one for the background, one for the text and one for emphasis).
3. There should not be too much information in one single slide. Each slide should have just enough information. What needs to be shown is important points about the topic, and not the entire lesson.
4. Too many slides in one lesson suffocate students. Therefore, teachers should use each single slide for a good reason. The main topic should first be identified and slides should revolve around the important aspects of this topic. Also, familiar information for the students should not be included in the slides.
5. There should not be a timer in the slides because each slide requires a different amount of time.
6. If possible, well-designed diagrams or graphics need to be used. These can explain much more than text.
7. Pre-designed slides by other people or publishers should be avoided because these slides may be too limited or too comprehensive (Either prepare your own slides or adapt pre-designed slides for your own topic).
8. Slides should not be allowed to substitute the lesson. They should be used as complimentary materials, not as the sole lesson. Slides may also be used to initiate class discussions for important topics.

As can be seen, visual materials with their many different forms may be used for instruction, enhance teacher and student performance (Greenberg, Raphael, Keller & Tobias, 1998) and enable easier learning than texts (Bouchlaghem, Wilson, Beacham & Sher, 2002). In addition, visual materials enable students to have fun as they learn (Butler & Mautz, 1996; Cramer, Collins, Snider, & Fawcett, 2007; Oluk & Özalp, 2007). These materials help students focus on the topic and make connections with “real life” problems (Hoffman & Ritchie, 1997). This is caused by the light, colors, movement and sounds of visual materials (such as video, pictures, diagrams, etc.), which develop learning behaviors (Yalçın et al., 2003). A previous study stated that well-designed visual materials can deliver a more effective message than dozens of written pages, achieve aims in a shorter time, and thus should be used so that teachers can learn issues about the subjects they teach more easily and permanently (Düzgün, 2000).

The present study examines the effects of instruction with visual materials on preservice elementary teachers’ deficiencies and misconceptions in global warming, on their amendment, and on giving the preservice teachers a positive attitude towards global warming. It was thought that this would reveal whether instruction with visual materials is sufficient in educating more qualified teachers in global warming. Previous comprehensive studies have shown that visual materials are powerful tools of education for teachers to use (Thompson & Wiegmann,
A survey of the literature showed that computer assisted instruction and instruction with visual materials (video, pictures, ppoint, etc.) were effective in rectifying misconceptions, ensuring permanent learning and increasing academic success in the fields of biology (Yakışan, Selvi & Yürük, 2007; Dubowy et. al., 2006; Köse, Ayas & Taş, 2003), physics (Düzgün, 2000), chemistry (Dori & Barnea, 1997), mathematics (Dursun & Peker, 2003) and geography education (Yaşar, 2004), as well as psychology (Cramer, Collins, Snider, & Fawcett, 2007) and economics (Blaclock & Montgomery, 2005). A study about global environmental problems is especially noteworthy. In this study, Oluk and Özalp (2007) showed that the use of cartoons and comics gave more effective results on elementary level than the use of traditional instructional methods in the teaching of environmental problems such as global warming, ozone layer depletion and acid rain. Cartoons and comics were observed to facilitate the teaching of these problems, drew students’ attention to the topic and brought an element of fun to classes. The preference of visual materials in the present study results from the successful outcomes obtained in previous studies in the field of education as well as other disciplines and the relatively few numbers of tertiary level studies concerned with instruction with visual materials, particularly in the issue of global warming.

PURPOSE
Answers to the following questions were sought with the present study:
1. Does instruction with visual materials have an effect in rectifying preservice teachers’ deficient knowledge and misconceptions about global warming?
2. Does instruction with visual materials have an effect in changing preservice teachers’ environmentally friendly behaviors adopted to curb global warming?
3. Does instruction with visual materials have an effect on the attitudes of preservice teachers towards global warming?
4. Does instruction with visual materials have an effect in changing the daily habits of preservice teachers to curb global warming?

METHODOLOGY
Research Model
Qualitative and quantitative research methods have been used jointly in this study. The quantitative method of experimental-control group pretest-posttest experimental design and the qualitative technique of semi-structured interview was utilized. Before and after the study, the participating preservice teachers were given demographic information questionnaires, 2 open-ended questions and the Global Warming Attitude Scale (GWAS) designed by the researcher (Bozdogan, 2009a). In addition, a 4-item semi-structured interview was held at the end of the study with 6 students randomly selected from among the experimental group students (n=23). While traditional instructional methods (lecturing and question-answer) were used in the control group during the study, class activities (hand-on activities, work-shop) and instruction with visual aids were used in the experimental group.

Sample
The study was conducted in Giresun University, Faculty of Education, Department of Elementary School Education in Turkey. The sample included preservice teachers in their 6th semester of study, who had previously taken the course “Environmental Education” between September 2007 and January 2008 (during their 4th semester of study) and passed the course successfully. The Environmental Education course was scheduled as two hours per week and the total contact hours were 28. In this course, the basic concepts of global warming were introduced in a unit entitled “ecological problems”, which lasted 4 hours. Traditional methods of education (lecturing, discussion, question and answer) were used. The course included two examinations: one midterm and one final. A total of 98 preservice teachers took the course and 9 failed the midterm and final exams. When the examination papers of these 9 candidates were analyzed, their answers about the basic concepts of global warming were seen to be unsatisfactory and they were thus excluded from the study. The 89 preservice teachers were given the demographic information questionnaires, the 2 open-ended questions and the GWAS. When the experimental and control groups were formed, GWAS pretest total scores (experimental group $X = 3.58$, control group $X = 3.60$ and $t_{(45)} = 0.167$, $p>.05$), areas of interest (physics, chemistry, biology, astronomy, etc.), and their sources of information about global warming were considered. Equivalent control and experimental groups were formed from the 47 preservice teachers whose ages ranged between 20 and 23. The demographic features of experimental and control groups are given in the table below.
Table 1: Demographic information of experimental and control group preservice teachers (f)

<table>
<thead>
<tr>
<th>Demographic information</th>
<th>Control Group</th>
<th>Experimental Group</th>
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<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
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<tr>
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<td>7</td>
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<td>Girls</td>
<td>14</td>
<td>16</td>
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<td>Interest</td>
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<tr>
<td>Biology</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Physics-Astronomy</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>Chemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Information Source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tv</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Internet</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Magazine-Newspaper</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>School-Course Books</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>No source</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>23</td>
</tr>
</tbody>
</table>

Implementation Process

Week 1 (50’x3): During the first week, the same process was followed in both experimental and control groups. Three different tests were implemented to form the experimental and control groups. The first one was the demographic information questionnaire (age, gender, areas of interest, following the news about global warming, etc.), the second was the 2 open-ended questions, and the third was the GWAS. Analyses of total scores from the demographic information questionnaire and the GWAS helped the allocation of preservice elementary teachers to the experimental and control groups.

Week 2 (50’x2): The experimental group preservice teachers were made to watch an approximately 80-minute documentary film giving information about the reasons and results of global warming. After the film, a short 20-minute evaluation was held with the students. With the control group preservice teachers, traditional instructional methods (lecturing, question-answer, etc.) were used to give information in a 2-hour session about the reasons of global warming. During this, the teacher had an active role.

Week 3 (50’x2): In the experimental group, the researcher gave a presentation about the environmentally-friendly behaviors needed to curb global warming individually in and outside the home. Experimental group students were divided into 8 to form workshop groups. These workshop groups were then asked to analyze a minimum of 5 visual materials displaying the effects of global warming (photographs, animations, cartoons, comics, etc.) and prepare them as a presentation for the following week. Each student group was also asked to prepare posters related to the topic. In the control group, the preservice teachers were given a 2-class-hour session about the results of global warming using traditional methods (lecturing, question-answer etc.). During this session, the teacher had an active role.

Week 4 (50’x3): In the experimental group, presentations prepared by the workshop groups were presented. Each group was given 15 minutes. The visual materials used in presentations treated the topic of global warming in a reason-result relationship. For the evaluation of visual materials, techniques such as class discussions and brain storming were used. Later, the workshop groups presented their posters about global warming and they were voted in the classroom. The most voted posters were displayed on bulletin boards around the faculty. In the control group, traditional instructional methods (lecturing and question-answer) were used once again by the researcher to inform the students about the environmentally friendly behaviors that may be used to curb global warming individually in and outside the home. Then, question-answer was used for an evaluation.

Week 5 (50’x2): Posttests were implemented in both the experimental and control group. During this process, the two open-ended questions in the pretest and the GWAVS were implemented again.
Week 6 (50’x2): Semi-structured interviews were held with 6 randomly selected preservice teachers (3 females, 3 males) from the experimental group. These individuals were asked 4 questions. During this week, nothing was done with control group students.

**Data Collection**

Data were collected in four stages.

1. In the first stage, demographic information questionnaires were utilized. This part aimed to identify gender, age, area of interest (biology, physics, chemistry, astronomy, etc.), and sources of information about global warming.

2. In the second stage, two open-ended questions were asked to measure students’ global warming information levels. These questions were 1. How do you define Global Warming? and 2. What do you think about the actions we can take individually at home and outside to curb Global Warming? What kinds of precautions do you take?

3. In the third stage, the GWAS, which was developed by the researcher (Bozdoğan, 2009a), was implemented to identify students’ global warming attitudes and value levels. Consisting of 37 items, this was a Likert type scale with the following scores: 1 “Disagree completely”, 2 “Disagree”, 3 “Undecided”, 4 “Agree” and 5 “Agree completely”. The KMO value of the scale was 0.928 and the Barlett value 5980.243. Total correlation values of the items ranged between 0.468-0.757. Factor load values of items gathered in the first factor and the factor load values of the 37 items were 0.476 and higher. The Cronbach Alfa reliability coefficient of the scale was $\alpha = 0.94$.

4. In the fourth stage, semi-structured interviews were held with 3 female and 3 male students selected randomly from the experimental group. The questions asked were: 1. Did the experimental study with visual materials change your perspective on global warming? How? 2. Has a change occurred in your process of following global warming news? How? 3. Have you given up any habits to curb the effects of global warming? Can you exemplify? 4. What sort of work will you undertake to raise your students’ awareness when you start to teach?

**Data Analysis**

Data obtained were analyzed by using quantitative and qualitative data analysis techniques. The former included frequency, t-test and Covariance analyses, while the latter included the two open-ended questions measuring students’ level of information about global warming and focus group interviews. Data obtained from these qualitative analysis techniques were classified and grouped independently by 3 different researchers. These groups were then coded and compared under the same roof. Frequency distributions (f) were obtained from the data and preservice teacher views supporting the analysis results were included.

**RESULTS**

**Part 1: Analyses of Preservice Teachers’ Answers to the Open-ended Questions**

In this part of the study, preservice teachers’ answers to the two open-ended questions were analyzed to identify their global warming information levels.

**Question 1.** How do you define Global Warming?

Experimental and control group preservice teachers’ answers to the questions were analyzed and the table below was compiled.

<table>
<thead>
<tr>
<th>Group</th>
<th>Correct Knowledge</th>
<th>Misconception</th>
<th>Errorous Knowledge</th>
<th>Correct Knowledge</th>
<th>Misconception</th>
<th>Errorous Knowledge</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>5</td>
<td>10</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>5</td>
<td>24</td>
</tr>
<tr>
<td>Experimental group</td>
<td>5</td>
<td>14</td>
<td>4</td>
<td>14</td>
<td>6</td>
<td>3</td>
<td>23</td>
</tr>
<tr>
<td>TOTAL</td>
<td>10</td>
<td>24</td>
<td>11</td>
<td>22</td>
<td>15</td>
<td>8</td>
<td>47</td>
</tr>
</tbody>
</table>

In the present study, the number of control group preservice teachers who had misconceptions about the reasons for global warming was 10. With the study, the number decreased only to 9. Similarly, the number of those with deficient knowledge decreased from 7 to 5. However, the outcomes in the experimental group were rather different. The number of preservice teachers who had misconceptions about the reasons for global warming decreased from 14 to 6. The number of those with deficient information decreased from 4 to 3. These results
show that instruction with visual materials was better than the use of traditional instructional methods in rectifying the misconceptions of preservice teachers about the reasons for global warming.

The pretest answers of control group preservice teachers showed that 8 held the misconception that “global warming happens due to ozone layer depletion”. Of the other 2 preservice teachers, one stated that “a decrease in river flow rate causes global warming”, while the other one said that “global warming occurs when the Sun’s rays reaching the earth cannot be kept but reflected”. The posttest answers of control group preservice teachers showed that 5 continued their misconception that “global warming happens due to ozone layer depletion”. Out of the other 4 preservice teachers, one insisted that “a decrease in river flow rate causes global warm”, and another one that “global warming occurs when the Sun’s rays reaching the earth cannot be kept but reflected”. Another preservice teacher stated that “global warming occurs when poisonous gases released into the air cause atmosphere depletion and when more of the Sun’s rays reach the earth”. The last preservice teacher’s answer is worth noting: “global warming happens when nitrogen in the atmosphere increases and the earth temperature rises”.

The pretest answers of experimental group preservice teachers showed that they had similar misconceptions as the control subjects. Ten of the preservice teachers held the misconception that “global warming happens due to ozone layer depletion”. Of the remaining 4 preservice teachers, 3 said that “global warming happens due to the temperature differences between day and night”, while the remaining one stated that “global warming occurs because more of the Sun’s rays reach the earth due to atmosphere depletion”. The posttest answers of these preservice teachers revealed that 4 persisted in their misconception that “global warming happens due to ozone layer depletion”. Two others still said that “global warming happens due to the temperature differences between day and night”.

Question 2. What do you think about the actions we can do individually at home and outside to decrease Global Warming? What kinds of precautions do you take?

Answers of the 22 preservice teachers in the experimental and control groups were analyzed and their views were tabulated as follows.

Table 3: Distribution of individual environmentally friendly behaviors (f) of experimental and control groups to combat global warming

<table>
<thead>
<tr>
<th>Group</th>
<th>Tests</th>
<th>I don't do anything</th>
<th>I save water</th>
<th>I save energy</th>
<th>I don't litter the environment</th>
<th>Educational activities</th>
<th>Others</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>Pretest</td>
<td>7</td>
<td>14</td>
<td>14</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>9*</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>4</td>
<td>13</td>
<td>16</td>
<td>8</td>
<td>3</td>
<td>10*</td>
<td>54</td>
</tr>
<tr>
<td>Experimental group</td>
<td>Pretest</td>
<td>5</td>
<td>15</td>
<td>14</td>
<td>2</td>
<td>---</td>
<td>4**</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>---</td>
<td>23</td>
<td>23</td>
<td>2</td>
<td>3</td>
<td>11**</td>
<td>62</td>
</tr>
</tbody>
</table>

* Using recycled products, following news items about global warming, avoiding waste in food consumption, becoming a member of environmental organizations, planting trees.
**Planting trees, using recycled products, making use of solar energy, using mass transportation.

Not much difference is observed between the control group’s pretest and posttest answers concerning behaviors to combat global warming. In the pretest, 14 preservice teachers mentioned water consumption (limiting shower time, turning taps off while brushing teeth or shaving, etc.) and energy consumption (using energy-saving light bulbs, unplugging electronic tools such as TV or computer and not leaving them on stand-by, not using too much fuel for heating, making use of solar energy, etc.). The results of the posttest resembled those of the pretest. Thirteen of the preservice teachers said they took care in water consumption, while took care in energy consumption. In addition, control group individuals were found to display behaviors related to avoiding environmental littering (pretest 6 people; posttest 8 people) and to educational activities (pretest 2 people, posttest 3 people). While the pretest showed that 7 preservice teachers did not exhibit environmentally friendly behaviors, the number decreased to 4 in the posttest.
The answers of experimental group preservice teachers showed a different situation. While 15 of the preservice teachers said they took care with water consumption in the pretest, this number increased to 23 at the end of the experimental study. The case with energy consumption was also similar (pretest 14 people, posttest 23 people). Therefore, it may be said that the experimental study contributed to the development of more thoughtful behaviors about global warming, and particularly about water and energy consumption, in all preservice teachers. Other behaviors displayed by the experimental group preservice teachers did not vary significantly. These included not littering the environment (pretest 2 people, posttest 2 people) and educational activities (posttest 3 people). While 5 of the experimental group preservice teachers never displayed any environmentally friendly behaviors prior to the experimental study, this situation was entirely rectified afterwards.

Part 2: Analyses of Preservice Teachers’ Responses to the GWAS

This section analyzes and tabulates experimental and control preservice teachers’ responses to the GWAS scale.

Table 4: T-test results of related samples concerning experimental group pretest - posttest scores

<table>
<thead>
<tr>
<th>Measurement</th>
<th>N</th>
<th>X</th>
<th>S</th>
<th>sd</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>23</td>
<td>3.58</td>
<td>0.36</td>
<td>22</td>
<td>-4.445</td>
<td>.000</td>
</tr>
<tr>
<td>Posttest</td>
<td>23</td>
<td>3.82</td>
<td>0.32</td>
<td>22</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4 shows that the mean pretest total score of the experimental group was (X = 3.58), while their mean posttest total score was (X = 3.82). This difference between pre and posttest scores was statistically meaningful and in favor of the posttest (t(22) = -4.445, p<.001). Correlation between the pre and posttest scores of the experimental group was 0.732, and impact factor was d=0.93. According to this finding, the experimental study can be said to have a significant effect on the development of attitudes against global warming among preservice teachers.

Table 5: T-test results of related samples concerning control group pretest - posttest scores

<table>
<thead>
<tr>
<th>Measurement</th>
<th>N</th>
<th>X</th>
<th>S</th>
<th>sd</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>24</td>
<td>3.60</td>
<td>0.47</td>
<td>23</td>
<td>-1.647</td>
<td>.113</td>
</tr>
<tr>
<td>Posttest</td>
<td>24</td>
<td>3.70</td>
<td>0.37</td>
<td>23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5 reveals that the mean pretest total score of the control group was (X = 3.60), while their mean posttest total score was (X = 3.70). This difference between pre and posttest scores was not statistically meaningful (t(23) = -1.647, p>.05). Correlation between the pre and posttest scores of the control group was 0.761, and impact factor was d=0.33. These results imply that traditional instructional methods did not have a meaningful effect in developing attitudes against global warming in the control group.

Table 6: Descriptive statistics of experimental and control preservice teachers’ GWAS pretest- posttest attitude scores

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Tests</th>
<th>Total Means</th>
<th>Estimated Marginal Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>sd</td>
</tr>
<tr>
<td>Control Group</td>
<td>24</td>
<td>Pre-test</td>
<td>3.60</td>
<td>0.47</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post-test</td>
<td>3.70</td>
<td>0.37</td>
</tr>
<tr>
<td>Experimental Group</td>
<td>23</td>
<td>Pre-test</td>
<td>3.58</td>
<td>0.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post-test</td>
<td>3.82</td>
<td>0.32</td>
</tr>
</tbody>
</table>

\[X_e\] : Estimated posttest means

Table 7: ANCOVA results of posttest scores adjusted according to pretest in both groups

<table>
<thead>
<tr>
<th>Source</th>
<th>Type SS</th>
<th>Sum of df</th>
<th>Mean Square</th>
<th>F</th>
<th>p</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>3.103</td>
<td>1</td>
<td>3.103</td>
<td>55.977</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>.193</td>
<td>1</td>
<td>.193</td>
<td>3.482</td>
<td>.069</td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>2.439</td>
<td>44</td>
<td>5.544E-02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>5.699</td>
<td>46</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R Squared = .572 (Adjusted R squared = .553)
Analysis of covariance results showed that when pretest total scores were controlled, it was not meaningful with respect to posttest adjusted mean scores \(F_{(1,44)} = 3.48, p>.05\). Although a meaningful difference did not exist between the posttest mean scores of the groups, the mean of the experimental group \(\bar{X} = 3.83\) was higher than that of the control group \(\bar{X} = 3.70\). According to this, the experimental study partially developed preservice teachers’ attitudes against global warming when compared to traditional instructional methods.

Part 3. Results of Semi-Structured Interview with Experimental Group Preservice Teachers
In this part of the study, interviews held with preservice teachers were analyzed.

Question 1. How did the experimental process supported by visual materials change your outlook on global warming?

All of the preservice teachers who were interviewed stated that global warming was a more serious and sensitive topic than they thought it to be, and that they now had a larger perspective on the reasons and results of global warming. All of the preservice teachers emphasized that visual materials had a significant effect on this process. Some preservice teacher views were as follows:

**Orkun:** I had some rough idea about global warming. With this study, I learnt the reasons for global warming. I learned that it occurs due to \(\text{CO}_2\) emissions. I actually didn’t know that. From now on, I will be more responsible.

**Ahmet:** I had some rough idea. For instance, that the polar ice was melting. But I had never been visually presented such information. Obviously, we came to see the grimness of the issue. As our earlier environmental education sessions covered global warming only via lecturing, we didn’t get really interested in the issue. But the documentaries we watched and the photographs we saw enabled us to see the issue from a larger perspective. I now have a much better idea about how the polar ice is melting and why polar bears are threatened.

**Arzu:** We had theoretical information about the issue. But such information does not usually grab your interest. When we see visual information, we start to think about it. In short, I learnt that everything is in the hands of humans.

**Elmas:** I thought global warming was a recent problem. But the documentary showed me that global warming has actually been around since the 1950s, as evidenced by various studies. I also only thought about the reasons-results of global warming in Turkey. But I noticed that certain countries significantly cause global warming and this is a worldwide problem.

Question 2. What can you say about following news articles about global warming after the experimental study?
Preservice teachers’ answers to this question showed that all 6 preservice teachers who were interviewed sometimes followed news stories about global warming in print and visual media before the experimental study but did not take them seriously; they became more careful and conscious afterwards and were upset about negative results. Some of the opinions of preservice teachers were as follows:

**Durali:** I now follow this issue more consciously and I worry. From recent scientific studies about the earth, I can see that there are serious problems.

**Orkun:** Previously I sometimes followed news items about state policies but now I’m more selective about news on energy saving.

**Ahmet:** To be honest, I previously did not take this issue seriously and did not think that it was an important issue. But I became more curious as a result of the study. What is happening? What country is doing it? Why don’t these countries reduce their \(\text{CO}_2\) emissions? Now I have more interest in these issues.

**Halime:** Previously, I wouldn’t stop to think about global warming. But now I understand the gravity of the situation, I listen to news stories with more attention and I get really upset when I read negative stories about global warming.

**Elmas:** I used to follow news stories about global warming every now and then. For instance, I heard it that Holland was going to be submerged in water. But now I also follow issues about particularly consumption, for instance energy saving air-cons, lighthubs and fridges.

Question 3. Have you given up any habits in order to curb the effects of global warming? Can you exemplify?
Four of the interviewed preservice teachers admitted that they previously had habits that contributed to \(\text{CO}_2\) emissions, and that they gave up on them. Two preservice teachers said that they did not have any habits that
increased CO₂ emissions but they still became more careful in their electricity and water use. Below are some views from the preservice teachers:

**Ahmet:** Previously, I never used to unplug the computer or TV, I even took naps in front of the TV. But now I take utmost care about these.

**Halime:** In addition to saving energy and water, I also take care about raising the awareness of people around me. For instance, as my mother is pedantic about cleaning, a lot of water is wasted for excessive cleaning at our home. I talk to my family and warn them. I now notice my mother saving significant amounts of water, which makes me very happy.

**Elmas:** I used to use a night lamp. I was scared of the dark and I also liked its colors. But now I’ve given up altogether. Also, I look for the recycle logo when I go shopping. I also try to set a good example for others with my actions.

**Arzu:** Every time there is an interesting class at university, I always share it with my room mates at the dormitory. For instance, I make my mates turn the lights off when not needed at the dorm. I even set limits on their bath times. They tell me it’s enough but I stand firm and I emphasize the dangerous results of global warming. They’ve got used to me now.

**Question 4.** When you become a teacher, what types of work will you undertake to raise your students’ awareness?

Five of the preservice teachers stated that, similar to this experimental study, they were going to use visual materials (videos, photos, etc.) and make room for social activities (student clubs, campaigns in the city, etc.). The views of 6 preservice teachers are given below:

**Ahmet:** First, I plan to support social activities. I want to be a leader in establishing clubs about these topics and organizing social activities. In addition, I will use visual materials to demonstrate the seriousness of the topic. But I believe the most permanent will be games and drama. We still remember the games we used to play when we were 5, don’t we? Therefore I’d like to organize such activities.

**Halime:** I will prefer field trip and observation activities. If I work in an industrialized area, I may take students to these sites, show them the fumes from the chimneys and discuss their effects on the environment. They can then see the results for themselves. I will support this by using visual materials showing other sources of CO₂ emissions.

**Durali:** I’ll give information by using visual materials and make them bring news items and photos from visual print media to the classroom and discuss them. I will display these news items or other visual materials that I prepare on school bulletin boards. I will therefore try to use these boards actively.

**Orkun:** If we can give young children positive attitudes about this issue, it will become their lifestyle. I know that we have responsibility in this issue. Therefore, as a person who believes in the permanence of information presented through visuals, the first thing I’ll do will be to explain the gravity of the situation with photos and documentaries. I will establish a discussion environment using these visuals and critical thinking. By using thought-provoking questions such as “What should we do in these circumstances?”. I will make my students understand this concept.

**Arzu:** I would like to raise my students’ awareness by organizing various activities. For instance, I will prepare brochures and posters, establish student clubs, and use social interaction more to make students aware. Also, various campaigns need to be organized in the city or town. For instance, awards may be given to students and schools who collect the biggest number of en disposed batteries. Another way to raise awareness may be to make elementary pupils play games and participate in drama activities.

**Elmas:** My first deed as a teacher will be to divide the waste bin into 3. Therefore students will get into the habit of separating glass-plastic and paper waste. Then, I would definitely like to use visual materials to show my students the reasons and results of global warming. They will achieve more permanent learning and be more aware. In addition, as the issue of global warming is a contemporary one, it may also be linked to other courses such as life studies, social studies and Turkish, and different activities may be possible.

**DISCUSSION AND CONCLUSION**

This study compared instruction with visual materials and traditional instructional methods in improving preservice teachers’ global warming information levels, rectifying their deficient information and misconceptions, developing environmentally friendly behaviors against global warming, and increasing their attitudes towards global warming. Although the preservice teachers in the experimental and control groups were given 4 hours of global warming instruction using traditional methods (lecturing, question-answer) during the environmental
education course of the previous year and they all passed this course, both groups were found to have information
deficiencies or hold misconceptions before the study. The most common misconception both in the control (8 people)
and experimental (10 people) groups was that “global warming happens due to ozone layer depletion”. This
misconception is rather common in tertiary level studies (Boyce & Stanisstreet, 1996; Read, Boström, Morgan, Fischhoff, & Smuts, 1994; Dove, 1996; Groves & Pugh; 1999; Summers, Kruger, Childs & Mant, 2001; Khalid, 2001; Pekel, 2005; Michail, Stamou & Stamou, 2007; Matkins & Bell, 2007). This study also found misconceptions that are less frequent in the literature. Among the control group, other misconceptions were “a decrease in river flow rate causes global warming” (1 person), “global warming occurs when the Sun’s rays reaching the earth cannot be kept but reflected” (1 person), “global warming occurs when poisonous gases released into the air cause atmosphere depletion and when more of the Sun’s rays reach the earth” (1 person) and “global warming happens when nitrogen in the atmosphere increases and the earth temperature rises” (1 person). In the experimental group too, certain uncommon misconceptions were spotted: “global warming happens when nitrogen in the atmosphere increases and the earth temperature rises (3 people)” and “global warming occurs because more of the Sun’s rays reach the earth due to atmosphere depletion” (1 person).

In the present study, success in the control group where traditional instructional methods were used to rectify the
information deficiency and misconceptions about the reasons for global warming was approximately 12%. On the
other hand, in the experimental group where visual materials were used, it was approximately 40%. It thus
follows that instruction by visual materials yields more successful results in rectifying the information deficiency
and misconceptions about the reasons for global warming.

The environmentally friendly behaviors adopted against global warming were similar in the two groups before
the study. The control group individuals were seen to be mostly concerned with water (14 people) and energy (14
people) use. In the experimental group too, the biggest concern was water (15 people) and energy (14 people)
consumption. It is believed that preservice teachers took measures about energy use as it causes global warming,
and they took measures about water use as global warming depletes water resources. At the end of the study, the
two groups still exhibited the same behaviors, but with a difference in the total distribution. An approximate
increase of 4% was seen in the environmentally friendly behaviors in the control group, while the rate of increase
in the experimental group was 65%. These results reveal that when preservice teachers are instructed with visual
materials as opposed to traditional methods, they consider the future effects of global warming and behave more
consciously. Both control and experimental group members were actually observed not to have any deficient
information or misconceptions about the behaviors exhibited for curbing global warming. These behaviors by
preservice teachers parallel the findings of Groves and Pugh’s 1999 study and Yılmaz, Morgil, Aktug and Göbekli’s 2002 study. It is noteworthy that although both experimental and control group preservice teachers had many deficiencies in information and misconceptions according to the pretest results of the present study, they possessed adequate and accurate ideas about the behaviors needed to curb global warming.

This was attributed to print and visual media in previous studies. In these studies, preservice teachers mentioned
print and visual media as their top source of information about global warming and other environmental problems
(Hillman, Stanisstreet & Boyes, 1996; Shanahan, Morgan, & Stenbjerre, 1997; Khalid, 2001; Yılmaz, Morgil, Aktug & Göbekli, 2002; Öztas & Kâlpci, 2009; Hansen, 2009). However, reporters with deficient and insufficient information may cause question marks in the minds of the public. The media may also exaggerate the issue in an unscientific way and thus misguide the audience (McBean & Hengeveld, 2000; Schreiner, Henriksen & Hansen, 2005). For instance, although CH4 is a more dangerous greenhouse effect inducing gas than CO2, the media do not mention it much. Therefore, when preservice teachers utilize print and visual media to complete their shallow and deficient information about the environmental problems that are intertwined in complex ways, misconceptions arise. Indeed, a previous study showed that some students did not remember their classroom education but behaved in line with the information they gathered from the press (Khalid, 2001). This was the case in the present study, too. Both groups of preservice teachers mostly used print and visual media as their information resource about global warming. However, the posttest responses of the experimental group showed an improvement in their deficient information and misconceptions. This is thought to be caused by using visual resources (pictures, photographs and video images) in the classroom, which draw students’ attention and are used by the visual media to inform the society. It is thus believed that instruction with visual materials, which draw the attention of preservice teachers, may be useful in rectifying deficient information and misconceptions. Certain studies recommended that cooperative learning, problem-based learning, critical thinking based instruction techniques (McBean & Hengeveld, 2000; Khalid, 2001; Schreiner, Henriksen & Hansen, 2005; Doğru, 2008) and specially prepared environmental education programs may be used to rectify these misconceptions and offer a more effective education to preservice teachers about environmental problems (Shin, 2000).

Another result of the present study was that traditional instructional methods had a weak effect \[t_{23} = -1.647, p>.05; d=0.33\] while education supported by visual materials had a strong effect \[t_{22} = -4.445, p<.05; d=0.93\] on
the development of global warming attitudes in preservice teachers. In addition, analysis of covariance results showed that when pretest total scores were controlled, the groups were not meaningful with respect to adjusted mean posttest scores \(F_{1,44}=3.48, p>.05\). Although a meaningful difference did not exist between the mean posttest scores of the two groups, the higher mean score obtained by the experimental group (\(X = 3.83\)) than the control group (\(X = 3.70\)) suggests that the experimental study improved students’ global warming attitudes more than traditional instructional methods did. Considering that short-term experimental studies may not be sufficient for students to develop permanent attitudes towards environmental issues (Hart & Nolan, 1999), the small difference between the attitude total scores of the control and experimental groups in the present study may be attributed to its 3 week duration (7 class hours). Longer-term studies may be conducted to clarify these issues.

All 6 of the randomly selected preservice teachers from the experimental group said in the semi-structured interviews that the issue of global warming was a more serious and sensitive issue than they thought and they now had a larger perspective on the causes and effects of global warming. All 6 preservice teachers who were interviewed also emphasized that visual materials had been rather influential in this process. At the same time, all preservice teachers said that they followed the news stories about global warming in the print and visual media with more attention and awareness, and worried seriously about the negative consequences. Four of the preservice teachers who were interviewed stated that they used to have certain habits that contributed to CO₂ emissions (using night lamps, taking a nap in front of the TV, etc.) but they gave them up. Five of the preservice teachers also said that, similar to the present experimental study, they are going to use visual materials (videos, photos, etc.) when they become teachers and stress the importance of social activities (student clubs, campaigns in the city, etc.). As can be seen, the answers of preservice teachers to interview questions reveal the effects of instruction with visual materials on them.

The present study showed that, when compared to traditional instructional methods, instruction with visual materials led to a partial increase in preservice teachers’ information and attitude levels about global warming. In addition, it also seemed to draw preservice teachers’ attention in the topic. In off-the-record talks with preservice teachers after classes, they stated that such visual materials made learning more fun and meaningful, increased their interest in the topic, and other classes should also incorporate the use of visual materials. Indeed, previous studies also found similar findings (Butler & Mautz, 1996; Cramer, Collins, Sniper, & Fawcett, 2007; Oluk & Özalp, 2007). Seen from this perspective, the experimental study may be considered a success as it increased the interest of preservice teachers in the issue. More interest may encourage preservice teachers to gather more conscious and careful information from informal learning environments, and it may as a result increase their information and attitude levels and make the learning of the topic in the classroom more effective. Previous studies also revealed that preservice teachers who are interested in environmental issues have higher information and attitude levels than others (Pe’er, Goldman & Yavetz, 2007) and when they have better subject area information, they also have more equipped pedagogical information (Kaya, 2009). In addition, during the process of instruction with visual materials, preservice teachers prepared several visual presentations, which gave them an opportunity to prepare and present visual materials. This gave them potential for the future to more effectively present units about environmental problems with the support of visual materials. Taber and Taylor (2009) conducted an 8-week study in Australia with 29 elementary pupils and revealed that individual activities and effective visual education tools significantly improved students’ information levels about global warming and climate change. They also found that activities and visual education tools had a positive effect on student skills related to the topic. In another study, Darçın, Bozkurt, Hamalosmanoğlu & Köse (2006) stated that, in order for elementary pupils to meaningfully learn global environmental problems which include abstract concepts like greenhouse effect, they need to learn by doing and their instruction needs to be enriched by encouraging, curiosity-raising and interesting materials (overhead projector, slides, etc.).

In order to raise more aware generations, it is essential to make preservice teachers understand the gravity of global warming, which is ignored by most people due to its gradually appearing effects. Teachers or preservice teachers have a critical place with respect to environmental education. They are key agents that develop and disseminate new educational practices (Kapyla & Wahlstrom, 2000). The present study showed that visual materials, which were shown to be effective in other fields (Dori & Barnea, 1997; Düzgün, 2000; Dursun & Peker, 2003; Köse, Ayas & Taş, 2003; Yaşar, 2004; Dubowy et. al., 2006; Yakişan, Selvi & Yürük, 2007), also had an important function in revealing global warming. Therefore, educating preservice teachers in the matter of global warming by using visual materials (documentaries, photographs, ppoint presentations, etc.) at university may have positive consequences. In addition to this, various social activities may be organized at education faculties (preparing posters and t-shirts, establishing student clubs, etc.). Lester, Maa; Leea & Lambert (2006) stated in a study that social activities may help raise more aware individuals about global warming. Visual materials may also be used at the schools where preservice teachers perform their teaching practice to raise students’ awareness.
IMPLICATIONS FOR FURTHER STUDY
In addition to the present study, which was conducted to reveal the effects of instruction with visual materials on global warming, multiple data are necessary. Extending the current study over a longer period of time will particularly help the achievement of positive attitudes. In addition, this experimental study which was conducted with preservice elementary teachers may be replicated with preservice teachers from other departments such as Science Education, Turkish, Preschool Education. Such studies may also include inservice elementary teachers to obtain a larger perspective.

LIMITATIONS
As the sample size of the study was small, it needs to be supported by larger-scale studies to reveal the effects of instruction with visual materials.

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THE EFFECTS OF PRE-READING AND SHARING MECHANISMS ON LEARNING WITH THE USE OF ANNOTATIONS

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ABSTRACT
This study is aimed at investigating students’ annotation behaviors and their effects on learning achievement with pre-reading (reading before class) exercises and Web-based sharing mechanisms. An 8-week quasi-experiment was conducted with 125 sixth-grade elementary school students. The study shows the following results. First, a significant correlation was evident between pre-reading with a Web-based annotation tool and learning achievement. Furthermore, implementing a pre-reading sharing mechanism with Web-based annotation capabilities could stimulate and help students perform more useful pre-reading by reviewing others’ annotations, thereby enlarging the effectiveness of pre-reading as it relates to learning. Second, participants’ pre-reading exercises with a Web-based annotation tool revealed their preparation before class as well as reflected their prior knowledge, thereby helping the instructor to prepare the lecture well in advance. In the future, more advanced mechanisms, such as self-regulation learning, will be studied to encourage students to efficiently manage learning before class.

Keywords: Pre-reading; Annotations; Improving classroom teaching

INTRODUCTION
Students engage in an especially helpful and useful practice by making annotations, such as comments or explanations, to learning materials. In particular, the use of a Web-based annotation tool during lectures or after class has positive influences on students’ learning achievement and it stimulates students’ motivation to learn (Hwang, Wang & Sharples, 2005). Pre-reading appears to be a good way to help students prepare for learning in class because students’ readiness to learn is an important factor to achieve effective learning (Zhang, 2001). However, few studies have concentrated on the pre-reading with a Web-based annotation mechanism and how this mechanism affects learning achievements. In this study, we investigate whether learning before class (pre-reading) with a Web-based annotation mechanism could help students perform significantly better than students who did not engage in pre-reading exercises or pre-read with traditional textbook. Learner annotations written in class could be a useful way to assess students’ understanding about the lecture (Lin, 2006). Thus, in this study, we determine whether learner annotations written before class could help teachers understand students’ prior knowledge and preparation before class. Furthermore, we study whether a sharing mechanism could facilitate learner pre-reading skills and facilitate more effective annotations in a Web-based environment.

LITERATURE
Influence of pre-reading on learning achievement
Pre-reading refers to reading or studying before class. In other words, pre-reading conveys one’s readiness before class. “The most important single factor influencing learning is what the learner already knows” (Ausubel, 1978, p. 163). Additionally, “a primary process in learning is subsumption in which new material is related to relevant ideas in the existing cognitive structures” (Kearsley, 2000). Thus, meaningful pre-reading refers to being prepared before learning takes place, while trying to relate new learning material to previous knowledge (Zhang, 2001). The process of making annotations helped students to connect lecture content with prior knowledge (Peper & Mayer, 1978), including integrating new concepts of a lecture into meaningful learning (Ausubel, 1968) and generative learning (Wittrock, 1974). Paul (1979) also indicated that making preparations is an effective way to help create “learning-ready” students and Chan (2005) indicated that the preparations for the pre-test, which were held 10 minutes before each class, could stimulate students to work hard and gain some knowledge of the learning materials before class. Qiao and Zhao (2008) developed a Web-based pre-test to improve teaching quality. However, the above studies were mainly concerned that the learning effects resulted from the students’ prior knowledge in the field, and were not related to the pre-reading strategy. In addition, the two studies did not further uncover students’ pre-reading behaviors such as the quantities and types of note-taking.

Spies and Wilkin (2004) showed that before each class, the students who were responsible for reading a legal case displayed a greater understanding of the learning materials than students who were not expected to prepare for a pharmacy law course. Chiu and Lee (2009) considered that a pre-class video viewing of the lecture content and hands-on laboratory activities in class enhanced the learning of high-school students’ basic image processing. Chen (2008) showed that pre-reading helped learners capture key points and incomprehensible concepts before class, so they could
focus their attention on the parts of the lecture related to those key points and concepts previously not fully understood.

The findings in the Chung and Fan study (2007) showed that when a teacher requested that students pre-read before class and did not plan activities well to stimulate pre-reading, it was found that some students did not attain good learning readiness for the lecture and did not perform well on exams. Sun and Huang (2005) conducted an experiment with an experimental group and a control group, employing traditional instruction with or without asking for pre-reading Web-based learning materials. The results indicated that the pre-reading group received significantly higher scores than the group that did not pre-read. Unfortunately, the study did not further investigate the factors leading to the results, such as the strengths of Internet-like sharing and any detailed engagement students were involved in before class. As previously mentioned, learning readiness is an important factor and worth studying in detail with well-designed activities or mechanisms to stimulate additional pre-reading.

**Influence of annotation on learning performance**

Annotation refers to marking extra information on reading documents. According to Marshall (1997), annotation can be divided into two parts: explicit annotation and inexplicit annotation. The former (e.g., text) conveys more explicit meaning than the latter (e.g., highlighting, underlining, asterisks, arrows, and graphics) for the original annotator, which conveys the common meaning (Marshall, 1998). According to these different forms of annotations, Marshall (1997) proposed six annotative functions for the original annotator to use during later reviewing. Inexplicit annotation features procedural function signals for marking an area already known, or for a desire to know, place-marking for aiding memory, and drawing for a situ method of a working problem. Explicit annotation, however, functions as short notes that may combine the inexplicit for interpretation, reflections, or for a visible trace of a reader’s attention (Marshall, 1997).

Literature, such as the following, showed that annotation has the potential to facilitate the effectiveness of learning. Annotations positively affected learning achievement; the more annotations were made, the greater learning achievements were obtained (Petri, Miikka, Jaako, Patrik & Henry, 2005). Meanwhile, annotating learning material is an effective learning strategy to promote students’ reading comprehension (Chang, Chen & Chen, 2006) by highlighting or underlining key concepts (Shaughnessy & Bake, 1988) and it effectively reduces the readers’ cognitive overload by allowing them to write short notes related to reading materials (Marshall, 1998). Finding key concepts and the supporting related facts in the material have been regarded as the necessary basic skills for reading comprehension and summarization capabilities (Zimmerman, 1986).

With the growth in digital learning activities and the Internet, annotation on Web-based learning materials has gradually attracted worldwide attention. Yeh and Lo (2009) presented an experiment and developed a Web-based interactive system, called Online Annotator for EFL Writing, for giving feedback on second language writing of college freshmen by marking annotations. The results of the study showed that students who were arranged in a Web-based annotation tool group have significantly better error recognition learning performance than those who were arranged in a paper-based annotation group. This enhanced performance was due to the limited amount of corrective and feedback information displayed in annotations shared by a teacher or peers (Yeh & Lo, 2009).

Su, Yang, Hwan and Zhang (2010) conducted a study and designed a Web 2.0 collaborative annotation system, called the Personalized Annotation Management System 2.0, to examine the relationship between learning achievements and the quantity of annotations created by college freshmen during or after a lecture. The study revealed that the annotation sharing mechanism is a key to strengthen students’ learning achievements (Su, Yang, Hwan & Zhang, 2010).

According to the previous studies, annotations created by students during lectures or after class have positively correlated with students’ learning achievement. However, few studies further explore the effectiveness of annotations created before class on learning achievement, and the correlation between learning achievement and annotations created before class.

**Perceived usefulness and system ease of use and activity design with an annotation sharing mechanism**

Perceived usefulness and perceived ease of use proposed by Davis (1986) have been widely used to predict user attitudes toward information technology (Chang & Yang, 2010; Park, 2010; Selim, 2003). Perceived usefulness refers to the belief that using an information system will increase and improve their performance. Perceived ease of use refers to the belief that using an information system will be free of effort (Selim, 2003). A person’s behavior toward an information system was determined by his attitude concerning perceived usefulness and perceived ease of use (Davis, 1986).

Recently, online interpersonal knowledge sharing networks have become popular, like Facebook, Twitter, etc. As for reviewing annotations marked by other students, Hicks (2003) emphasized that shared annotations have an advantage of allowing for informal sharing of personal knowledge related to an artifact or concept. Sharing mechanisms have been widely applied in Web-based learning environments to promote the following effects: to stimulate the motivation to
involve students in learning activities and help them move forward toward learning goals (Hwang, Wang & Sharples, 2005; Silvia & Andy, 2003); to achieve better learning performance by collaborating with peers by sharing and accessing their own ideas of learning materials (Hwang, Wang & Mike, 2007; Su, Yang, Hwang & Zhang, 2010); to obtain the benefits of peer learning, such as offering more learning opportunities through conversation or dialogue via sharing annotations (Glover, Xu & Hardaker, 2007; Wolfe, 2002); to learn a peer’s methods of how to accomplish a specific task via sharing and discussing their annotations with other peers (Cobos & Pifarré, 2008); and to support learner-center collaborative learning for adult and adolescent students via a shared document-based annotation tool (Nokelainen, Miettinen, Kurhila, Floréen & Tirri, 2005). Thus, making annotations is not only helpful for enhancing individual learning, but it is also a useful way to facilitate peer learning through sharing annotations.

Therefore, in this study the perceived usefulness and perceived ease of using a Web-based annotation system, called Virtual PEN (VPEN), with a pre-reading stimulus were employed to explore student attitudes toward our proposed activities and system. Furthermore, the effect of the pre-reading stimulus using VPEN, with/without sharing for learning, was deeply investigated and the reasons behind it were also analyzed.

RESEARCH METHOD

Research objectives

The purpose of this study is to investigate the effects of pre-reading modes with/without a sharing mechanism and annotation tools on learning achievement. Meanwhile, students and the instructor perceived the role of pre-reading and the sharing mechanism on learning. Three research objectives were proposed.

1. The effects of the pre-reading modes, with the Web-based annotation tool or with traditional paper and pen, on learning achievement were investigated.
2. Pre-reading modes with a Web-based sharing mechanism were conducted along with their influence on learning achievement and the quantity of annotations.
3. The students’ and instructor’s perceptions about pre-reading, the VPEN tool, and the sharing scenario were explored.

Research participants and subject

Four classes, a total of 125 sixth-grade elementary school students, participated in a total of two phases of this experiment. Shown in Table 1, four classes are divided by the pre-reading and annotation tool into four segments. The left column (“Experiment” and “Control B”) asked for pre-reading while the right column did not require pre-reading (“Control A” and “Control C”). The top row (“Experiment” and “Control A”) employed the VPEN tool while the bottom row (“Control B” and “Control C”) employed a traditional paper and pen approach. The subject in this study is a social course in a sixth-grade elementary school and the learning material in this study is the textbook.

![Table 1: Pre-reading Modes and Tools](image)

<table>
<thead>
<tr>
<th>Tool/Pre-reading Modes</th>
<th>Pre-reading Group</th>
<th>Group Not Asked to Pre-read</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web-based learning materials with VPEN for annotation</td>
<td>Experiment: 30 students</td>
<td>Control A: 32 students</td>
</tr>
<tr>
<td>Textbook with paper and pen for annotation</td>
<td>Control B: 31 students</td>
<td>Control C: 32 students</td>
</tr>
</tbody>
</table>

Research variables and structure

The independent variables of this research are (1) pre-reading, (2) the annotation tool, and (3) the sharing scenario. The dependent variables in this research are (1) learning achievement and (2) the quantity of annotation. The same teacher taught the all participants. The participants also learned the same material (the “Experiment” and “Control A” learned from the Web-based version of textbook, while the “Control B” and “Control C” learned from the paper-based textbook) within the same learning period and schedule. Meanwhile, the statistical method of Analysis of Covariance (ANCOVA) was employed to exclude the difference of participants’ prior knowledge between the groups; these are the controlled variables in this research. The research variables include the followings.

1. Pre-reading: In this study, pre-reading refers to studying before class. See Table 1(“Experiment” and “Control B” constitute the pre-reading group, which asked to pre-read learning materials before class while “Control A” and “Control C” did not ask).
2. Annotation tool: The annotation tool consists of VPEN annotation and paper-based annotation. The former, the VPEN tool, was a Web-based annotation system while the latter used a pen to annotate paper-based learning materials (“Experiment” and “Control A” are the VPEN annotation group. “Control B” and “Control C” are the paper-based annotation group).
3. Sharing scenario: The Web-based annotation tool with a sharing annotation mechanism was provided for the “Experiment” and “Control A” to support student learning and pre-reading for the social course in phase 2. Figure 4 is an illustration of the sharing mechanism for viewing classmates’ annotations.
4. The quantity of annotations: The total number of annotations created before class, in class, and after class,
which consisted of explicit and inexplicit annotations.

(5) Participants’ prior knowledge: The scores of the pre-test measured prior knowledge.

(6) Learning achievement: The scores of the post-test measured learning achievement.

(7) Figure 1 illustrates the structure of the research variables. Research objective one, mentioned in Section, “Research objectives”, was to identify the effects of two variables (pre-reading and annotation tool) on learning achievement by two-way ANOVA (lines 2 and 3). Furthermore, Pearson’s correlation was employed to further investigate the correlation between achievement and the quantity of explicit or inexplicit annotations made before class. According to research objective two, mentioned in Section, “Research objectives”, the sharing mechanism was explored to identify its influence on learning achievement by two-way ANOVA (line 5). Furthermore, research objective two was also instituted to explore whether there is a significant difference in the quantity of annotations between the classes with/without pre-reading by T-test in two phases without/with a sharing mechanism (lines 4 and 6). In the third research objective, the attitudes of students and the instructor toward the system and the proposed activities were explored via interviews or questionnaires.

**Experimental procedures**

An 8-week quasi-experiment, with each week devoting 2 hours to the research, was conducted. The intervention is divided into two phases without or with a sharing mechanism to identify the effects of pre-reading, the annotation tool, and the sharing annotation mechanism on learning and the attitudes of the instructor and students toward them. The experimental procedures are described as follows (and illustrated as Figure 2).

(1). Training activities: Training and practices are conducted for the use of the VPEN tool in the VPEN group and for pre-reading in the pre-reading group before the first phase. The training of the use of a Web-based annotation sharing mechanism was conducted in the VPEN group before the second phase. The learning materials used in the training activity are the lessons of the textbook in the social course, which are not part of the learning materials used in intervention. The training of the VPEN tool is focused on how to login/logout of VPEN, annotating the learning material in explicit or inexplicit annotations, and how to save the annotations. The training of the Web-based annotation sharing mechanism is focused on how to view the annotations made by classmates in phase 2. The activities of pre-reading include guiding questions, which were given by the teacher to facilitate students to annotate and to think about main ideas and the learning materials’ incomprehensible concepts before class. Meanwhile, the students were asked to label their annotations as “uncomprehending idea,” “main idea,” etc.

(2). Pre-test: Before each phase, a total of two pre-tests were held for four classes to measure the students’ prior knowledge.

(3). Intervention (two phases): Four classes are assigned the same learning activities and the same instructor during a lecture. The learning activities in class include the following: guiding questions at the beginning of a lecture, the instructor’s lecture, and peer discussion. Only the pre-reading group asked to pre-read before
class. The pre-reading and training activities are the same. In the first phase, the Web-based annotation tool and pre-reading modes were employed without a sharing mechanism. In the second phase, for the VPEN group, the “Experiment” with pre-reading and “Control A” without pre-reading are conducted with the sharing mechanism while the paper-based annotation group, “Control B” and “Control C,” are not prohibited nor encouraged to share annotations made in textbooks.

(4). Post-test: After each phase, a total of two post-tests are held for four classes to measure the students’ learning achievements. The post-tests are held 2 weeks after the intervention.

(5). Questionnaire and interview: At the end of the experiment, a questionnaire or interview are held in order to identify the instructor’s and students’ perceptions toward pre-reading, the VPEN tool, and the sharing mechanism.

(6). Data collection and analysis: The collected data depend on research objectives. Thus, the data include the scores of the pre-test or post-test, the quantity of annotations that were calculated by the concept-based coding, the questionnaire data, and the interview data. The analytical method of these data has been proposed in Section, “Research variables and structure”.

**Instruments**

**VPEN system**

The VPEN is a multimedia Web annotation system developed by Hwang and Wang (2004), which is composed of features to annotate online learning materials, such as highlighting and underlining. It also affords the user the ability to write comments in text or in a sound-recording format as well as to read or share annotations. Figure 3 is an illustration of the use of the VPEN system. Meanwhile, the contents of annotations are recorded in a Microsoft® SQL server. Furthermore, each annotation contains useful information, such as the type and time of the annotation, which was used to identify if the annotation was made before class.

**Learning materials, pre-test, post-test, and questionnaire**

Learning materials in all classes include four lessons in a sixth-grade social course textbook. The pre-test and post-test consist of multiple-choice and open-ended questions, which are designed by the researcher and revised by domain
experts in order to exclude and modify ambiguous and unsuitable questions. The questionnaire, adapted from Selim (2003), was composed of open-ended questions and response questions with 5 dimensions, 32 items in a 5-point Likert scale, as shown in Appendix 1.

RESULTS

Reliability of the questionnaire

SPSS software is used to analyze the reliability of the questionnaire. Cronbach’s alpha is employed to evaluate the internal consistency of each dimension of the questionnaire (1951). The result, Table 2, shows that all dimensions in the questionnaire are higher than 0.70. According to Wortzel (1979), the questionnaire would be highly reliable if the Cronbach alpha value is higher than 0.7; while it would be unreliable if it is less than 0.35. In other words, the reliability of the questionnaire is sufficiently high.

Table 2. Questionnaire dimension and Cronbach alpha values

<table>
<thead>
<tr>
<th>#</th>
<th>Dimension</th>
<th>Cronbach Alpha Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Perceived usefulness of VPEN</td>
<td>.878</td>
</tr>
<tr>
<td>2</td>
<td>Perceived usefulness of pre-reading</td>
<td>.897</td>
</tr>
<tr>
<td>3</td>
<td>Perceived usefulness of sharing annotation mechanism on learning</td>
<td>.877</td>
</tr>
<tr>
<td>4</td>
<td>Perceived usefulness of sharing annotation mechanism on pre-reading</td>
<td>.906</td>
</tr>
<tr>
<td>5</td>
<td>Perceived ease use of VPEN</td>
<td>.766</td>
</tr>
</tbody>
</table>

Validity of the questionnaire

During the process of designing the questionnaire, the sentences of the items were modified for children of the same age and similar background to ensure understanding. The items were also verified and validated by experts. The ambiguous and unsuitable questions were removed, modified, and arranged in a proper procedure.

Results of questionnaire analysis

The goal of the questionnaire was to survey participants’ perceptions in five dimensions (i.e., usefulness of VPEN, usefulness of pre-reading, usefulness of the sharing annotation mechanism for learning, usefulness of the sharing annotation mechanism for pre-reading, and VPEN ease of use). The questionnaire was given to 93 participants (30 in the “Experiment”, 32 in “Control A,” and 31 in “Control B”), and 90 completed questionnaires were received (a 96 percent return rate). The following are the perceived usefulness of three factors (pre-reading, VPEN and sharing mechanism) on learning and the perceived ease use of VPEN.

Perceived usefulness of VPEN on enriching annotations

As shown in Appendix 1, most participants strongly believed that VPEN can help them make annotations more fruitful by 67 percent. Furthermore, it was believed that VPEN can make it more convenient to annotate main points (e.g., marking, erasing, and updating the annotations) by 73.3 percent, and the tool makes referencing easier between annotations and online supplementary information by 81.7 percent. Similar opinions are also found in the open-ended question, “What do you think is the usefulness of VPEN on learning?” For example:

“I think that VPEN is helpful because there are lots of detailed online resources and it is more fruitful than a textbook. I could use online resources in VPEN when I made annotations.”

“It was always helpful. I use a Web-based dictionary to understand special terms and then write it down in VPEN.”

Meanwhile, Figure 3, sampled from VPEN tool logs, also demonstrates this statement. The fruit image in the textbook was not the fruit produced in the participant’s hometown at that time. Thus, the participant used the image of a local fruit (strawberry) to enrich the contents in Web-based learning material and made a text annotation that buying the cake decorated with the local season fruit (strawberries) would be cheaper, which matches with the learning goal: how to consume correctly.
However, there are a few opposing opinions that claim the Web-based annotation system (VPEN) is not convenient for learning, which was found in the open-ended question, “What do you think is the usefulness of VPEN on learning?” For example:

“My parents did not allow me to use the computer before the exam so I could not see annotations in VPEN.” “No, I seldom use it because I couldn’t see annotations at home every day.”

Perceived usefulness of pre-reading on learning performance

As shown in Appendix 1, overall the participants have positive responses to the usefulness of pre-reading on learning performance. Pre-reading is useful for them particularly in figuring out the main ideas in learning materials by 75.9 percent, and in finding the ideas before class, which were not previously understood by 65.5 percent. Thus, 65.5 percent think pre-reading helps them to more efficiently understand the lecture in class and makes them more confident to perform well in class. It was believed that pre-reading is useful to learning and helpful to complete homework by 79.3 percent.

The perceived usefulness of pre-reading on listening efficiently during a lecture is also demonstrated by the opinions found in the open-ended question, “What do you think is the usefulness of pre-reading on learning? For example:

“It helped me memorize main ideas if I could study it before class. If I could find main ideas before class, then I could more understand what my teacher taught in class.”

“In order to get better performance in pre-reading, I need to find more relative resources and it helped me absorb more knowledge and it was easier to make sense of what my teacher taught. Meanwhile I could quickly answer the questions that the teacher asked; it was so funny.”

However, a few opposing opinions were given against the usefulness of pre-reading. The following statements were written in the open-ended question, “What do you think is the usefulness of pre-reading on learning?” For example:

“I think that one who could perform well is someone who has already been working well, and one who cannot perform well is someone who cannot work well initially. So pre-reading is not a key point.”

“What my teacher spoke in class is clearer than what was written in the textbook. So I think that I do not need to read before class.”

Although participants had positive responses to the usefulness of pre-reading on learning performance, some of them perceived that they needed more learning companions during pre-reading. Some examples were illustrated in the following statements, which were found in the open-ended question: “What do you need while you pre-read before class?”

“I need some friends to discuss the learning materials while I pre-reading at home.”

“I need my parents to be with me while I pre-read at home…but my parents have no time to do it. Sometimes I want some friends to be with me while I pre-read.”

“I have tried my best to find some online resources related to the learning topic… I still want to see all of the...”
related resources found by all of my classmates but I did not want to ask them face-to-face because it is time-consuming...every time they update them or get new resources, I have to ask them again...I need my classmates to tell me their new or updated resources...but it is impossible.”
“...Pre-reading is really an effort-demanding job and that it is not easy to do by oneself”, which came from a participant in pre-reading with the paper-based annotation group.

Perceived usefulness of sharing annotations mechanism on facilitating pre-reading and learning

As shown in Appendix 1, overall the participants have a positive perception of the usefulness in sharing the annotation mechanism on facilitating pre-reading and learning. That is, sharing the annotation mechanism is useful for most of them; 71.5 percent of participants perceived that the sharing mechanism stimulates them to read classmates’ annotations, and 71.4 percent of the participants considered that reading classmates’ annotations helped them understand classmates’ learning process. A percentage of 60.7 felt that sharing stimulates them to make more annotations before class and 78.5 percent felt that sharing increased the quality of annotations made before the class. Thus, 78.6 percent of the participants think the sharing mechanism positively facilitates pre-reading, is helpful for their learning at a social course by 75 percent, and makes their learning easier by 71.7 percent.

The perceived usefulness of the sharing annotation mechanism on pre-reading and learning is also revealed by the opinions found in the open-ended question, “What do you think is the usefulness of the sharing annotation mechanism on pre-reading and learning?” For example:

“I could share something I feel important for my friends via VPEN...remind them take care of the main idea in the learning materials. ...Sometimes I am happy to get an annotation, which has a written idea related the materials for me.”
“I mark some annotations for my friends when I found something wrong in their annotations.”
“I write some annotations by myself. Through the sharing mechanism I can view my friends annotations...I find some main ideas in it so I rewrite my annotations at home before class.”
“I know I could find some friends online...I am not alone...if I find someone’s annotation is valuable, I will repeatedly review his annotations and update my annotations in the other way.”
“The contents in classmates’ annotations sometimes contain a list of reference Web site addresses...the online resources will be a valued reference material for me.”
“I could find useful information in my classmates’ annotations through the sharing annotations mechanism. Sometimes I could understand some concepts, which I did not realize initially through viewing classmates’ annotations before class. Hence, it encouraged me to be more engaged in pre-reading.”

In short, participants perceived that the sharing mechanism was useful for them in pre-reading and learning, presumably because of the cycle: annotations alone, viewing classmates’ annotations, and repairing original annotations. First, the participants annotate information by themselves. Second, they view the detailed information written in classmates’ annotations. Third, they repair and update the annotations written in the first step. The cycle will repeat again or it will go back to the second step. The participants pay attention to some classmates’ learning processes through repeatedly reviewing someone’s annotations and stimulating the annotations they made any time anywhere with computers, particularly the annotations made during pre-reading. Furthermore, the statements in the open-ended questionnaires seem to also reveal that most of the participants perceived that the VPEN sharing mechanism is not only an effective facilitator for pre-reading, but it also helps to form a pre-reading community for students, which encourages them to pre-read before class.

Perceived ease of use of VPEN

According to Appendix 1, 70 percent of participants think that the VPEN tool is easy to use. They particularly believe that they could easily find useful information in classmates’ annotations by 63.3 percent. However, around 36 percent of the participants thought that the process of learning how to operate the VPEN system was time consuming and VPEN was frustrating. The frustration stemmed from the Web environment and the VPEN Session protection mechanism; VPEN could not store annotations successfully due to users taking too long to act, according to interviews from participants who responded that they were frustrated. For example:

“I wrote some annotations in VPEN. Then I searched related information on the Web and it took me lots of time. When I came back, I continued to write some information in VPEN then I saved it. Some messages popped up. It told me, “Sorry! You are not logged in.” I lost the annotations I wrote about 10 minutes earlier.”

In the future, a notification mechanism will be adopted to avoid the situation mentioned above. For example, the message, “No actions in VPEN long time would make you logout of VPEN”. If it is written in the learning materials or warning system, it would be triggered before the activation of the VPEN Session protection mechanism, and it should be included in the VPEN system to warn users to take action.
Effects of pre-reading and the annotation tool on learning achievement

Effects of individual pre-reading and the annotation tool in phase 1

Based on the analytical results of two-way ANCOVA, as shown in Table 3, the findings indicate the following.

First, the effect of a participant’s prior knowledge (pre-test) on learning achievement (post-test) was significant \( F(1,120) = 20.357, p<.01 \). This means that the participants’ prior knowledge significantly affects participants’ learning achievement. Hence, employing ANCOVA to exclude the significant difference is the correct method.

Second, the interaction between pre-reading and annotation tools is insignificant \( F(1,120) = 3.21, p>.05 \). It means that the effects of learning achievement caused by one factor were independent to another factor; therefore, we could directly explore the main effect of two factors.

Third, although the mean of the post-test scores in the VPEN group (“Experiment” and “Control A,” \( M=78.61, N=62 \)) was higher than that in a paper-based annotation group (“Control B” and “Control C,” \( M=74.87, N=63 \)), there was no main effect for the annotation tool \( F(1,120) = 2.520, p>.05 \) while having controlled pre-test scores. It shows that the factor of the VPEN tool did not influence the students’ learning achievement.

Fourth, the main effect on pre-reading is significant \( F(1,120) = 12.921, p<.01 \), while controlled for the pre-test scores. The mean of the post-test scores in the pre-reading group (“Experiment” and “Control B,” \( M=80.11, N=61 \)) is higher than that in the group who did not request pre-reading (“Control A” and “Control C,” \( M=73.50, N=64 \)). It shows that learning achievement is significantly affected by pre-reading. The pre-reading factor influenced the learning achievement of a social course.

Table 3. Results of two-way ANCOVA, pre-reading, and an annotation tool without a sharing mechanism in phase 1

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>DF</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covariance (score of pre-test)</td>
<td>2087.344</td>
<td>1</td>
<td>2087.344</td>
<td>20.357</td>
<td>.000</td>
</tr>
<tr>
<td>Annotation tool</td>
<td>258.377</td>
<td>1</td>
<td>258.377</td>
<td>2.520</td>
<td>.115</td>
</tr>
<tr>
<td>Pre-reading</td>
<td>1324.832</td>
<td>1</td>
<td>1324.832</td>
<td>12.921</td>
<td>.000</td>
</tr>
<tr>
<td>Interaction</td>
<td>32.914</td>
<td>1</td>
<td>32.914</td>
<td>.321</td>
<td>.572</td>
</tr>
<tr>
<td>Error</td>
<td>12304.342</td>
<td>120</td>
<td>102.536</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>16292.752</td>
<td>124</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. **p<.01, *p<.05

Effects of pre-reading and the sharing mechanism on learning achievement in phase 2

Based on analytical results of the two-way ANCOVA, as shown in Table 4, the findings indicate the following.

First, the effect of participants’ prior knowledge (pre-test) on learning achievement (post-test) is not significant \( F(1,120) = 1.954, p>.05 \). It means that the participants’ prior knowledge did not significantly impact participants’ learning achievement.

Second, the interaction between two factors was insignificant \( F(1,120) = .102, p>.05 \). It revealed that the effect of one factor on a dependent variable (scores of post-test) would not be affected by another factor. Therefore, the main effect of two factors could be directly explored.

Third, by employing a sharing annotation mechanism, the result indicates that a main effect of the annotation tool is \( F(1,120) = 40.467, p<.01 \), which means that there is a statistical difference between the VPEN group (“Experiment” and “Control A”) and the paper-based annotation group (“Control B” and “Control C”). The mean score of the post-test \( M=83.15, N=62 \) in the VPEN group is higher than that in the paper-based annotation group \( M=73.19, N=64 \), which reveals that after employing a sharing mechanism, the learning achievements are significantly affected by an annotation tool with a sharing mechanism.

Fourth, the results indicate that a main effect of pre-reading is \( F(1,120) = 11.699, p<.01 \), which means that the pre-reading group and the group that did not ask for pre-reading have a statistical difference. The mean score of the pre-reading group was 80.8, while the group that did not pre-read was 75.58. In other words, learning achievements are significantly affected by pre-reading. The students would benefit from pre-reading and it facilitated the students’ learning achievement of a social course.

In short, according to Table 3, it found that pre-reading significantly affect learning achievement, Web-based annotation tool or paper and pen annotation tool would not significantly affect learning achievement. However, according to Table 4, after employing web-based sharing mechanism, Web-based annotation tool with sharing mechanism would significantly affect learning achievement. Meanwhile, the learning achievement \( M=86.2, N=30 \) of the pre-reading class with Web-based sharing annotation (“Experiment”) was significantly higher than the learning achievement \( M=75.58, N=31 \) of traditional pre-reading class with paper and pen annotation tool (“Control B”) \( t=4.862, p<.01 \). Thus, implementing a pre-reading sharing mechanism with Web-based annotation enlarge the effectiveness of pre-reading on learning achievement.
Table 4. Results of two-way ANCOVA, pre-reading, and an annotation tool with a sharing mechanism in phase 2

<table>
<thead>
<tr>
<th>Source</th>
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<th>DF</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covariance (score of pretest)</td>
<td>155.762</td>
<td>1</td>
<td>155.762</td>
<td>1.954</td>
<td>.165</td>
</tr>
<tr>
<td>Annotation tool</td>
<td>3226.111</td>
<td>1</td>
<td>3226.111</td>
<td>40.467</td>
<td>**.000</td>
</tr>
<tr>
<td>Pre-reading</td>
<td>932.624</td>
<td>1</td>
<td>932.624</td>
<td>11.699</td>
<td>**.001</td>
</tr>
<tr>
<td>Interaction</td>
<td>8.115</td>
<td>1</td>
<td>8.115</td>
<td>.102</td>
<td>.750</td>
</tr>
<tr>
<td>Error</td>
<td>9566.555</td>
<td>120</td>
<td>79.721</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>13709.952</td>
<td>124</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. **p<.01, *p<.05

Correlation between learning achievement and the quantity of annotations in pre-reading
According to Table 3 and Table 4, the learning achievement in the pre-reading group scored significantly higher than the group that did not employ pre-reading. Thus, it will be necessary to further investigate the correlation between learning achievements and the quantity of pre-reading annotations in different types of annotations (i.e., explicit and inexplicit annotations) in the pre-reading group while using the Pearson correlation and an interview.

Correlation between learning achievement and the quantity of inexplicit annotation in pre-reading
The results of two phases indicate that there were no positive relationships between learning achievement and the quantity of inexplicit annotation in pre-reading (phase1: r=.033, p>.05; phase2: r=.086, p>.05). With no textual comment cues, it is purely a heap of symbols consisting of lines and highlights and students may forget the meaning of the inexplicit annotation, according to the following statement made by a student who made inexplicit annotations.

“Sometimes I forget the meanings of the underlines. It might be a main point or something I have not reviewed.”

Correlation between learning achievement and the quantity of explicit annotation in pre-reading
All phases exist as a positive correlation between learning achievement and explicit annotation in pre-reading (phase1: r=.582, p<.01; phase2: r=.615, p<.01). Hence, those who made more explicit annotations during pre-reading also experienced greater learning achievement. It revealed that students could attain greater learning achievement if they make enough preparation via explicit annotations before class.

Meanwhile, an interesting phenomenon was found during the interview. Although annotations in class are important (Lin, 2006), making too many annotations in class would take much time to encode the lecture into annotations; therefore, it may interfere with students’ ability to carefully listen to the lecture. An interviewee made the following supporting statement:

“The speed of the lecture is far beyond the speed of my writing. For me, I need more time to think in class before taking notes. Taking too much time to annotate means that I would take too much time thinking and it would prevent me from listening to the lecture carefully.”

Furthermore, during the lecture, students would carefully listen to the main ideas that they did not understand before class. A student who was engaged in a pre-reading exercise mentioned the following supporting statement:

“I read the materials before class and I highlight something important and write down my answers following my teacher’s question list. During the lecture, what I need to do is listening to the part I did not understand initially. Then before the exam, I review the main points and the feelings I wrote. I found it was so clear and so many key points were made that it was not needed to find others.”

A statement from someone who did not pre-read reinforces this phenomenon:

“I did not know what message was important because my teacher made lots of key points. Do I need to write it down or memorize it? I know lots of important information given by my teacher was lost during the lecture. In order to prepare for the exam, I need more time to read the materials after class, but some of them I still could not figure out.”

It seems that pre-reading would affect the student’s learning behavior in class or after class. Thus, the effect of pre-reading on the different processes (in class and after class) should be investigated in a further study.

The effects of pre-reading modes with Web-based sharing mechanism on the quantity of annotation
It is evident that a student’s learning achievement is significantly affected by pre-reading (as shown in Table 3 and Table 4) and the Web-based sharing mechanism (as shown in Table 4). It is necessary to further investigate the effects of pre-reading modes with Web-based sharing mechanism on the quantity of annotation. Due to the difficulty of calculating the quantity of annotations in the group that used paper and pen, “Control B” and “Control C,” this study only analyzes the quantity of annotations in the VPEN group (the “Experiment” and “Control A”), a total of 62 participants.

According to Table 5, a significant difference exists between the classes with/without pre-reading in two phases. It
seemed that those who engaged in pre-reading made more annotations than those who did not engage in pre-reading. Thus, pre-reading plays an important role in facilitating students to be more engaged in reading materials and making annotations.

By employing a sharing mechanism, as seen in Table 5, the quantity of annotations increased in the pre-reading class, while the quantity of annotations decreased in another class without a request for pre-reading. Thus, the gap of the quantity of annotations between the two classes became larger due to the sharing mechanism in phase 2. According to the findings in the questionnaires and open questions, it is revealed that the sharing mechanism can help to form a pre-reading community for students, which encourages them to make more annotations before class. Thus, pre-reading with a sharing mechanism could be a promising and effective way to stimulate students to engage in more pre-reading exercises.

<table>
<thead>
<tr>
<th>Table 5. Total Annotations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Phase1</td>
</tr>
<tr>
<td>Phase2</td>
</tr>
<tr>
<td>N</td>
</tr>
</tbody>
</table>

Note. **p<.01
M = mean; SD = standard deviation

**Usefulness of the instructor’s perception toward pre-reading modes with VPEN**

The interview was applied in order to explore the instructor’s attitude toward pre-reading. In order to stimulate the instructor’s recall, the online annotations made by participants and the instructor were used during the interview. Moreover, the instructor thought the students’ annotations made in pre-reading helped him to understand the students’ prior knowledge and preparation before class, particularly from students’ annotations labeled “uncomprehending” and the annotations in response to the pre-reading guided questions. Furthermore, even the annotations, which students labeled “understanding,” revealed their preconceptions toward the main ideas on learning materials. The following are the interview contents of the instructor, in the interview outline, “What do you think is the usefulness of pre-reading modes with VPEN on your instruction?

“In my opinions, I found that it was a rapid way to realize students’ preparation and prior knowledge via the follow steps. First, I get an outline about who studied hard or who did not prepare before class via the quantity of annotations made by students before class, which is located at the bottom in VPEN. Second, I rapidly get a preliminary understanding on the contents, which most students feel are difficult, through annotations labeled ‘uncomprehending’ by students on Web-based learning material. Third, through the content of annotations and the answers for questions, which were used to guide students’ reading before class, help me get a more detailed understanding of their preconception about investment activities. Overall, through the three steps I found that most students understand that investment activities are activities for a profit fund and most of them illustrated an example of stock... Although students labeled that he/she knows the meanings of the paragraph, his/her annotations revealed that he/she has a poor understanding toward the investment activities.... For example, some students confused the concept between investment activities and the job they want to do in the future or what the meaning is of the decline of the stock..... Or, they think that investment activities refer to getting a profit before investment. Meanwhile, except for the stock investment, most students could not show me other investment examples and some of them know something about being careful before making investments but they have no idea about how to do it or where they could get the information to help them learn about being careful.... I prepared a sheet to describe my investment activities before class and prepared an activity for them to investigate their parents’ jobs and investment activities to help them understand what investment activities are and how to relate them with their lives.”

In short, the instructor perceived usefulness toward pre-reading modes with the VPEN tool, presumably because he could understand students’ prior knowledge through the following tricks: the screen presenting each student’s quantity of annotations (and illustrated as Figure 4), the contents labeled “uncomprehending” marked by the students, the students’ answers written in the pre-reading guided questions, and the detailed content written in annotations made by students. Through the tricks, the instructor knows there is a need to arrange an activity about investigating the parents’ jobs and their investment activities to help students understand how many investment activities relate to their lives, not only the stocks and the difference between jobs and investment activities. Thus, it helps the instructor to prepare well in advance for the lecture.
CONCLUSIONS AND DISCUSSION

This study is aimed at exploring students' annotation behaviors and uncovers the relationship between these factors, such as pre-reading, annotation tools, and sharing scenarios, quantity of annotations, and learning achievement. Due to limited reference studies found in this area and to avoid careless use of technology in education, a four-class and two-phase research was conducted in order to identify the interplay of pre-reading with a Web-based annotation tool. The analysis of learning performances and questionnaires revealed the following about the effectiveness of the VPEN with a sharing annotation mechanism in pre-reading activities.

First, learning achievement was significantly affected by pre-reading and pre-reading with a Web-based sharing mechanism was an effective way to help students be ready to learn. As the results from this study showed, the explicit annotations in the pre-reading exercises with a Web-based annotation tool had a significantly positive correlation with learning achievement. Meanwhile, the learning achievement in the pre-reading group scored significantly higher than the group that did not employ pre-reading and the learning achievement of the pre-reading class with Web-based sharing annotation was significantly higher than the learning achievement of traditional pre-reading class with paper and pen annotation approach. Furthermore, according to the questionnaire, the participants have an overall positive perception of the usefulness of a sharing annotation mechanism on enhancing pre-reading and learning. Participants perceived that an integrated VPEN tool with a sharing mechanism for pre-reading was an effective way to stimulate them to figure out more main points and to perceive more incomprehensible main points, which may make them pay more attention during a lecture. Thus, pre-reading with VPEN could be a useful learning strategy. We strongly emphasize that an integrated technology (a Web-based annotation tool with a sharing mechanism) in pre-reading was an effective way to help students prepare to learn.

Second, participant pre-reading with a Web-based annotation tool could reveal preparation before class and prior knowledge, thereby helping the instructor to prepare well in advance for the lecture. Through annotations made by participants in pre-reading via a Web-based annotation tool, the instructor could understand participants’ preparation and prior knowledge without offering a pre-test, which could help the instructor prepare well for the lecture, as mentioned in the interview. The annotations also implied that in the future there is a need to further examine whether adaptive learning could be applied according to such prior knowledge, which comes from the annotations written by participants.

Third, participants perceived the sharing annotation mechanism as an effective facilitator for pre-reading, stimulating more Web-based annotations before class, and thereby producing significantly better learning effects. The results from the questionnaire revealed that most of the participants in pre-reading classes were encouraged to continue pre-reading through the VPEN's sharing annotation mechanism. Meanwhile, the result in this study also found that the gap of the quantity of annotation between the classes with/without pre-reading from phase 1 to phase 2 was expanded by the sharing mechanism. Furthermore, the Web-based annotation tool with a sharing annotation significantly affected learning achievement. Thus, it implied that a sharing mechanism could facilitate pre-reading and stimulate more Web-based annotation, thereby producing a significantly better effect on learning.

Integrating a Web-based sharing mechanism into pre-reading is an essential way to facilitate pre-reading to stimulate more annotations before class and to prompt participants to overcome the demanding work of pre-reading through the
pre-reading community. Additionally, an integrated Web-based sharing mechanism produces significantly better effects on learning. In this research, the effectiveness of pre-reading, the annotation tool, and the sharing mechanism on learning was explored. However, how to conduct efficient pre-reading was not evaluated in this study. In the future, more advanced mechanisms, such as self-regulation learning, will be studied to encourage students to more efficiently manage their own learning before class.

ACKNOWLEDGEMENTS
This work was supported in part by the National Science Council (NSC), Taiwan, ROC, under Grant NSC-98-2631-S-008-001, NSC 98-2511-S-008-008-MY3 and NSC 98-2511-S-008-005-MY3 and the Research Center for Science & Technology for Learning of the University System of Taiwan.

REFERENCES


### Appendix 1: Questionnaire Results

#### Dimension 1: Perceived usefulness of the annotation tool: ("Experiment" and “Control A” respond, a total of 62 participants with 60 responses)

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>UD</th>
<th>DA</th>
<th>SD</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I feel the Web-based annotation tool is helpful for learning a social course.</td>
<td>43.3</td>
<td>31.7</td>
<td>20</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>I feel the Web-based annotation tool is useful for completing homework at a social course.</td>
<td>41</td>
<td>35</td>
<td>21.7</td>
<td>1.7</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>I feel the Web-based annotation tool makes the learning easier at a social course.</td>
<td>35</td>
<td>35</td>
<td>26.7</td>
<td>3.3</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>I feel the Web-based annotation tool makes annotating main points more convenient at a social course.</td>
<td>38.3</td>
<td>35</td>
<td>21.7</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>I feel the Web-based annotation tool enriches the contents of annotations.</td>
<td>41</td>
<td>26</td>
<td>30</td>
<td>1.7</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>I feel the Web-based annotation tool makes the reference more convenient between the contents of annotations and online supplementary information.</td>
<td>40</td>
<td>41.7</td>
<td>18.3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Dimension 2: Perceived usefulness of pre-reading: ("Experiment” and “Control B” respond, a total of 61 participants with 58 responses)

<table>
<thead>
<tr>
<th></th>
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<th>UD</th>
<th>DA</th>
<th>SD</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I feel pre-reading is helpful for learning a social course.</td>
<td>31</td>
<td>48.3</td>
<td>17.2</td>
<td>3.4</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>I feel pre-reading is useful for completing homework at a social course.</td>
<td>27.6</td>
<td>51.7</td>
<td>19</td>
<td>1.7</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>I feel pre-reading makes the learning easier at a social course.</td>
<td>32.8</td>
<td>41.4</td>
<td>20.7</td>
<td>3.4</td>
<td>1.7</td>
</tr>
<tr>
<td>4.</td>
<td>I feel pre-reading lets me have more confidence in performing well at a social course.</td>
<td>31</td>
<td>34.5</td>
<td>24.1</td>
<td>10.3</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>I feel pre-reading makes me more efficient in understanding the lecture.</td>
<td>22.4</td>
<td>43.1</td>
<td>29.3</td>
<td>5.2</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>I think that pre-reading is helpful for figuring out the main points of the learning materials.</td>
<td>27.6</td>
<td>48.3</td>
<td>19</td>
<td>3.4</td>
<td>1.7</td>
</tr>
<tr>
<td>7.</td>
<td>I think that pre-reading is helpful for finding the incomprehensible contents before class.</td>
<td>22.4</td>
<td>43.1</td>
<td>29.3</td>
<td>5.2</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Dimension 3: Perceived usefulness of the sharing annotations mechanism on learning: (only “Experiment” and “Control A” respond, a total of 62 participants with 60 responses)

<table>
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<tr>
<th></th>
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<th>UD</th>
<th>DA</th>
<th>SD</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I think Web-based sharing annotation mechanism is really helpful for learning a social course.</td>
<td>35</td>
<td>40</td>
<td>23.3</td>
<td>1.7</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>I think Web-based sharing annotation mechanism is useful for completing homework at a social course.</td>
<td>31.7</td>
<td>41.7</td>
<td>20</td>
<td>5</td>
<td>1.7</td>
</tr>
<tr>
<td>3.</td>
<td>I think Web-based sharing annotation mechanism makes the learning easier at a social course.</td>
<td>36.7</td>
<td>35</td>
<td>25</td>
<td>3.3</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>I think Web-based sharing annotation mechanism stimulates me more engaged in making annotations.</td>
<td>33.3</td>
<td>25</td>
<td>40</td>
<td>1.7</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>I think the Web-based sharing annotation mechanism encourages me to read classmates’ annotations.</td>
<td>33.3</td>
<td>38.3</td>
<td>21.7</td>
<td>6.7</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>I think the Web-based sharing annotation mechanism is useful for understanding the annotations made by classmates.</td>
<td>31.7</td>
<td>41.7</td>
<td>21.7</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td>I think the Web-based sharing annotation mechanism could improve the quality of the contents of my annotations.</td>
<td>35</td>
<td>35</td>
<td>28.3</td>
<td>1.7</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Dimension 4: Perceived usefulness of the sharing annotation mechanism on pre-reading: (only “Experiment” responds, a total of 30 participants with 28 responses)

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>UD</th>
<th>DA</th>
<th>SD</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I think that the sharing mechanism is helpful for pre-reading.</td>
<td>35.7</td>
<td>42.9</td>
<td>21.4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>I think that reading classmates’ annotations encourages me to be more engaged in pre-reading.</td>
<td>25</td>
<td>42.9</td>
<td>28.6</td>
<td>3.6</td>
<td>0</td>
</tr>
</tbody>
</table>
3. I think that the sharing mechanism is helpful for rapidly completing the pre-reading.  
   28.6 35.7 32.1 3.6 0 3.89
4. I think that the sharing mechanism stimulates me to be more engaged in making more annotations.  
   32.1 28.6 39.3 0 0 3.93
5. I think that the sharing mechanism stimulates me to read the annotations made by classmates during pre-reading.  
   28.6 42.9 25 3.6 0 3.96
6. I think that reading classmates’ annotations could stimulate me to make more annotations during pre-reading.  
   17.9 50 25 7.1 0 3.79
7. I think that reading classmates’ annotations could improve the quality of annotations made before class.  
   32.1 46.4 14.3 7.1 0 4.04
8. I think that the sharing mechanism was helpful for understanding classmates’ learning process through their annotations made during pre-reading.  
   25 46.4 17.9 10.7 0 3.86

**Dimension 5:**  
The ease of use of the web-based annotation tool (only “Experiment” and “Control A” respond, a total of 62 participants with 60 responses)

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>UD</th>
<th>DA</th>
<th>SD</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I think that using the Web-based annotation tool is very easy for me.</td>
<td>33.3</td>
<td>36.7</td>
<td>20</td>
<td>6.7</td>
<td>3.3</td>
<td>3.9</td>
</tr>
<tr>
<td>2. I think that the process of learning how to use the Web-based annotations tool is time-consuming.</td>
<td>23.3</td>
<td>13.3</td>
<td>35</td>
<td>25</td>
<td>3.3</td>
<td>3.28</td>
</tr>
<tr>
<td>3. I think that finding useful information from the annotations made by classmates is very easy for me.</td>
<td>30</td>
<td>33.3</td>
<td>31.7</td>
<td>5</td>
<td>0</td>
<td>3.88</td>
</tr>
<tr>
<td>4. I think that the using of the Web-based annotation tool frustrates me.</td>
<td>21.7</td>
<td>15</td>
<td>33.3</td>
<td>26.7</td>
<td>3.3</td>
<td>3.25</td>
</tr>
</tbody>
</table>

**Note.** SA = strong agree; A = agree; UD = undecided; DA = disagree; SD = strong disagree; M = mean  
The number in the table means the percentage of each column. For example, the number of the fourth item in dimension 5 at SA column means that 21.7 percent of the participants strongly agree.

**Open-ended questions:**
1. What do you think is the usefulness of VPEN on learning?
2. What do you think is the ease use of VPEN?
3. What do you think is the usefulness of pre-reading on learning?
4. What do you need while you pre-read before class?
5. What do you think is the usefulness of sharing annotation mechanism on pre-reading and learning?
THE IMPACT OF USING SYNCHRONOUS COLLABORATIVE VIRTUAL TANGRAM IN CHILDREN'S GEOMETRIC

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ABSTRACT
This study aimed to develop a collaborative and manipulative virtual Tangram puzzle to facilitate children to learn geometry in the computer-supported collaborative learning environment with Tablet PCs. In promoting peer interactions and stimulating students’ higher-order thinking and creativity toward geometric problem-solving, we designed a collaborative Chinese Tangram activity with problem-solving learning strategies. Participants are 25 6th graders of a suburb elementary school of Tai-Chung City. The results suggest that children’s competency in rotation and space of shapes had been improved and the scores gap between lower and higher achievers had been narrowed. Such a collaborative Chinese Tangram activity may facilitate peer negotiation, enhance children’s belief toward problem solving, and benefit each child to share resources, and a positive interdependent learning context can naturally be developed.

INTRODUCTION
In geometry teaching, Tangram puzzle could be used as an aid in presenting specific mathematical concepts, inspiring children's observation, imagination, shape analysis, creativity and logical thinking (e.g., Lee, et al., 2008; Olkun, Altun & Smith, 2005; Russell & Bologna, 1982; Sedig, Klawe & Westrom, 2001; Yang & Chen, 2010). It allows children to develop geometric concepts by categorizing, comparing and working out the puzzle, and thereupon to solve problems in geometric contexts. The proliferation of Information and communications technology (ICT) has added new facets to the limited physical learning resources by creating virtual learning aids. In the meantime, collaborative learning could also be supported by Internet, mobile technology and handheld devices. In traditional tangram games, individuals often played the game by him/herself. Even people played the game as a group, disorders often occurred when everybody lent a hand at those pieces. Pieces scrabbling might result in quarrels and fights and slow down the speed of completion. The virtual tangram was found to solve these problems. On the other hand, playing the virtual tangram game offered by Group Scribbles 2.0, a novel networked collaborative learning environment (see below for more details), could help students develop collective cognition and collaborative skills when play the game together and share with other groups. We conducted an experimental study with 25 Grade 5 (11-year-old) students in an elementary school. The objective of this research was to investigate whether the students can develop mathematics concepts through playing the Tangram puzzle collaboratively, and solving problems together through discussion. This article is structured as follows: The next section is a review of the literature. The third section describes the research design. The results for the various analyses are presented in the latter sections. Finally, conclusions are presented and suggestions are made for further research.

LITERATURE REVIEW
Geometry and spatial ability
Learning Geometry is a process of studying the conversion of graphics in the space, which can enhance children's spatial ability (Zhou, 1999; Do & Lee, 2009). Van Hiele (1986) proposed a five-level model describing how people learn Geometry. These levels are a product of experience and instruction, moving from visualization, analysis, abstraction, deduction to rigor. Children in the 6th grade of elementary school generally reach level 1 and start to move to level 2. At this stage, students should have gone beyond identifying basic geometric figures and analyze the properties of graphic, but also learn to recognize the relationships between types of shapes. Playing the Tangram puzzle is one of the significant methods to enhance geometric spatial thinking. The Tangram puzzle has been used in prior studies focused on computer supported learning (Scarlatos et al., 2002; Sedighian & Klawe, 1996). Actions of dissection, rearrangement and recomposing promote the imagination and logical thinking through observation and analysis (Clements & Battista, 1992).

Mathematical problem solving skills
Given emphasis on developing skills of mathematical problem solving in NCTM (National Council of Teachers of Mathematics) standard, peer work and discussion in the process of exploration are referred and strongly recommended (NCTM, 1990). Many researchers applied collaborative learning strategies to enhance students’ motivation and interest as well as their skills of mathematical problem solving (Ho, 2007; Liu, 1990). Working as a group and asking each group member to share their conversation has therefore been proven effective to approach the specific goal (Huang & Wu, 2006). Interactions among group members, collaboration and idea exchanges could give a push to deep thinking, exploration, reasoning and problem solving (e.g., Coleman, 2008).

One-to-one digital learning
One-to-one (1:1) technology enhanced learning refers to the setting of one or more computing device per student in a wireless networking environment for learning. The devices used for such a learning mode usually incorporate the following affordances: (1) portability; (2) supporting social interactivity; (3) personalization; (4) context sensitivity; (5) connectivity; and (6) bridging the cyberspace and the physical world (Chan et al., 2006). In 1:1 digital learning, instructors could make their choices of the most suitable devices for their teaching and learning purposes. Students' learning and interactive modes show greater variety in 1:1 digital learning classrooms (Roschelle, 2003; Zurita & Nussbaum, 2004a; Looi et al., 2009). The use of Tablet computer directs collaborative learning to a new horizon with the affordances of mobility and handwriting recognition. Mobility advances the interaction among group members on the move by keeping materials visible and usable to the whole group. One Tablet PC per person provides equal opportunities to each student to exchange ideas, sharing resource and gains immediately (Zurita & Nussbaum, 2004b).

Virtual Tangram
Virtual manipulations were regarded as a simulated learning tool on computers, allowing students to move, turn and rotate virtual objects on the screen through manipulating the keyboard and the mouse (Moyer, Bolyard & Spikell 2002; Sedig, 2008). In this study, we adopted virtual Tangram puzzle to support learning. Students were asked to discover the rules and the relationships of graphics in geometry by playing virtual Tangram puzzle, recomposing and representing the visuals. This would help students concentrate more on thinking and finish the composition more precisely.

Most current virtual learning aids could not satisfy the purpose of learner-centered learning for discussion and collaboration because of the lack of affordances for collaborative learning activities. With the rapid advancement of ICT, handheld devices and Internet communications offer real-time interaction for learning (Zurita & Nussbaum, 2004). Hence, the collaborative virtual learning aids could offer more new directions in supporting geometric learning which we were keen to explore in this study. The virtual Tangram puzzle inherits the advantages of traditional tangram but with more advanced features of remote playing and less risk of losing pieces. The result of virtual tangram puzzle could also be easily shared not only within a group but also inter-groups, by only projecting the screen for public view. Students can share their composition results of tangram for each other.

METHODS
Twenty-five Grade 6 (11-year-old) students (15 males, 10 females) from an elementary school in Tai-Chung City, Taiwan took part in this study. For analyzing different ability students’ learning achievement and collaborative strategies during the progress. They were first divided into eight groups of high-, medium- and low-ability according to the pre-test scores. There were 3 students in each of those seven groups and 4 students in the last group. The eight consist of two high-ability groups (Group 1 and Group 2), two medium-ability groups (Group 3 and Group 4), two low-ability groups (Group 5 and Group 6), and two mixed groups with high-, medium- and low-ability students (Group 7 and Group 8).

Group Scribbles (GS2.0), a computer-supported collaborative learning system developed by SRI International, was adopted to conduct small group collaborative for their puzzle-shape solving (Chaudhury et al., 2006; Looi, Lin & Liu, 2008). The interface of Group Scribbles in the figure 1 contains three main parts: public board, group board and private
board. The teacher can add, move and adjust the boards to his/her needs. The virtual Tangram puzzle was added to the toolkits. Each piece of the Tangram puzzle had numbers on it and can be rotated and moved freely.

**Experimental Process**

To develop geometric spatial sense and creative thinking, the researchers designed two tasks according to the two puzzle modes. The experiment lasted for four weeks and the process was as below:

1. **Pre-test (10 minutes):** The paper-and-pencil test was administered for students.
2. **Group Scribbles warm-up practice (30 minutes):** The teacher introduced to the students the electronic notes, the shared space and the concept mapping tool to familiarize them with the GS environment. The students then practiced to make a square with the Tangram puzzle set by rotating and moving each piece of the Tangram puzzle freely.
3. **Perform the task 1 (40 minutes):** Students in each group were required to make a funnel within 8 minutes (Figure 2). The results of each group were shared in the class and the teacher made some interpretation. During the classes, the teacher monitored the activities of all the groups and provided assistance where necessary.
4. **Perform the task 2 (40 minutes):** All groups practiced piecing up a sailing boat. Again 8 groups had a competition to complete a ‘sailing boat’ collaboratively within 8 minutes. Results were shared and peer assessment took place.
5. **Post-test and questionnaire (40 minutes):** The 10-minute post-test was administered promptly at the end of the intervention, which was followed by the administration of the questionnaire, which lasted another 30 minutes.
6. **Student interviews:** Semi-structured one-to-one interviews with ten students were then conducted in the final week.

The qualitative data consisted of students’ interviews that sought their perceptions in learning, and videos that recorded the whole process of intervention analyze their in-group interactions.

**RESULTS**

**Data analysis**

The researchers analyzed the results of the pre- and post-tests, collecting and comparing the lowest and highest score, mean and the Standard Deviation.

| Table 1: Average score and SD in Pre and Post tests |
|---------------------------------|---------------------------------|-----------------|--------|--------|--------|---------|
|       | Lowest score | Highest score | Average score | SD    | t      | Sig.     |
| Pre-test | 26           | 100           | 61.60          | 23.16 | -3.564 | .001**   |
| Post test | 40           | 100           | 73.28          | 18.99 |        |          |

Table 1 shows that there has been an increase of the lowest score, from 26 to 40. The overall mean was 11.68 points higher than the pre-test. The difference of the mean between pre and post-test is significant (p=0.001 <.01), which means that the target students had significantly improved their mean.

The researchers performed further analysis on the statistics by executing paired sample t-tests on their pre- and post-test results respectively.

| Table 2: Pre- and Post- test results of four groups |
|---------------------------------|----------------------------|-----------------|--------|--------|---------|
|       | Average | SD | t | Sig. |
| Group                  | Pre-test | Post-test | Pre-test | Post-test |        |         |
| High-ability group (n=6) | 83.00   | 84.67    | 8.17     | 6.28   | -0.542 | 0.305   |
| Medium-ability group    | 70.33   | 70.33    | 14.39    | 14.39  | -0.810 | 0.227   |

The qualitative data consisted of students’ interviews that sought their perceptions in learning, and videos that recorded the whole process of intervention analyze their in-group interactions.
Table 2 depicts that all groups scored higher in the post-test. Among these groups, the low-ability groups (p=0.02 <.01) and the mixed groups (p=0.013 <.01) had significantly improved their scores, catching up with the high and medium-ability groups.

To examine their learning gains in the target domain, the researchers had also conducted paired sample t-tests to the questions in pre- and post-tests according to various dimensions of geometric competencies. The competency dimensions are: basic shape rotation (Figure 4), spatial reasoning and sensing in Tangram puzzle (Figure 5), and piecing together the combinational shapes (Figure 6).

Table 3: The Competency of basic shape rotation in pre- and post-tests

<table>
<thead>
<tr>
<th>Rotation of basic shapes</th>
<th>Lowest score</th>
<th>Highest score</th>
<th>Average</th>
<th>SD</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>8</td>
<td>40</td>
<td>25.60</td>
<td>10.07</td>
<td>-2.347</td>
<td>.014*</td>
</tr>
<tr>
<td>Post-test</td>
<td>8</td>
<td>40</td>
<td>30.08</td>
<td>9.60</td>
<td>-2.940</td>
<td>.013*</td>
</tr>
</tbody>
</table>

Table 3 illustrates that the students received the score of 30.08 in the post-test, which is 4.48 higher than that in the pre-test. It also indicates that the students had enhanced their competency in basic shape rotation after the experiment (p=0.014 <0.5).

Questions 6 to 10 were about spatial reasoning and sensing with the Tangram puzzle set. For example, “in Figure 5, which of the piece has the same size as the piece No. 6?”

Table 4: The competency of spatial reasoning and sensing in pre- and post-tests

<table>
<thead>
<tr>
<th>Spatial reasoning with tangram</th>
<th>Lowest score</th>
<th>Highest score</th>
<th>Average</th>
<th>SD</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>0</td>
<td>40</td>
<td>24.32</td>
<td>10.95</td>
<td>-2.828</td>
<td>.005*</td>
</tr>
<tr>
<td>Post-test</td>
<td>8</td>
<td>40</td>
<td>30.72</td>
<td>8.54</td>
<td>-2.828</td>
<td>.005*</td>
</tr>
</tbody>
</table>

As it demonstrated in Table 4, the mean of students in the post-test measured 6.4 points higher than that in the pre-test and the p value is 0.005, reached the 0.05 level. From the statistic figures of Questions 1 to 5 and Questions 6 to 10, the changes in Questions 6 to 10 are more significant. This indicates participants had made good progress in the competency in spatial reasoning in this experiment and better understood the feature of Tangram.

Questions 11 and 12 were about piecing the combinational shapes with the Tangram puzzle set. For example, “What does figure 6 come to be when it is turned left 90 °?”

Table 5: The competency of piecing combinational shapes in pre- and post tests

<table>
<thead>
<tr>
<th>Combinational shapes composition</th>
<th>Lowest score</th>
<th>Highest score</th>
<th>Average</th>
<th>SD</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>0</td>
<td>20</td>
<td>11.60</td>
<td>8.00</td>
<td>-0.768</td>
<td>.225</td>
</tr>
<tr>
<td>Post-test</td>
<td>0</td>
<td>20</td>
<td>12.80</td>
<td>7.37</td>
<td>-0.768</td>
<td>.225</td>
</tr>
</tbody>
</table>

Table 5 shows that participants did make improvement and scored higher, though the difference was not significant.
(p=0.225). This indicates that children in the experiment didn’t promote much in their competency in piecing combinational shapes.

In short, the collaborative puzzle shaping with the Tangram puzzle can enhance the shapes rotation and spatial ability. Furthermore, the students’ competency in spatial reasoning and sensing had also been improved. Nonetheless, it did not show much help in developing the competency in piecing combinational shapes as no significant difference between the pre and post-tests. More exercises may be needed to develop the patterns of spatial capability with further in-depth study.

Patterns found in the process of collaborative tangram playing

During the process of this experiment, five patterns were found out from analysis of field notes and video recordings.

(1) Communication in the group: It was identified that the students had carried out a mixture of GS-based and face-to-face communications. Two people sitting next to each other often turned aside to watch one screen together when they had discussion. The third participant sitting opposite to those two, as illustrated in Figure 7, moved him/herself to the other side to view the same screen. This indicates all group members were engaged in the discussion. They carried out face-to-face discussion as well as online communications.

(2) Ways of collaboration: When a member in the group had difficulties in handling the Tangram puzzle on his/her computer, other members would move themselves to give help and make demonstration, as illustrated in Figure 8. Such behaviors helped to establish the sense of positive interdependence and sharing of failure and success, thus improving the collaboration. Gesticulating on the screen could be regarded as the replacement of actual pieces grabbing in traditional tangram. Within a group this physical behavior could be a great aid for verbal discussion.

(3) Sharing the achievement: One delegate of each group was asked to interpret their patterns of puzzle shaping and present the achievements of the group (Figure 10). Figure 9 illustrates the results of each group’s work. Students may find out other patterns of composition constructed by other groups on the public board of GS. By showing all groups’ results on the public board through projecting all students can discuss the work within the whole class, improving their individual knowledge through the collective knowledge.

(4) Discussion: The teacher explained the concept of poly forms, the same size in different shapes. The reflection of their problem-solving process would increase students’ understanding to the Tangram puzzle. In addition, the teacher interpreted the area concept of square, parallelogram and quadrilateral. As shown in Figure 11, the teacher could demonstrate the concept of area by both manipulating the virtual Tangram puzzle as well as drawing shapes on the board. The teacher found it easy to summarize and explain the geometrical concept based on students’ own collective cognition and knowledge.

(5) Peer group assessment: After Task 2, all students in the class did a peer assessment to other groups with ‘sheet’ and ‘stamp’ in GS in the scale of 1 to 5. The result of their peer assessment is displayed in Figure 12. Each group could easily obtain peer feedback in this way. That may encourage students to make rigorous observation which will lead to critical thinking.
Findings from the post-questionnaire

A post-questionnaire of the experiment was administered and analyzed according to Likert's five-point scale standard (Strongly agree, agree, Neutral, disagree and strongly disagree). We investigated the five facets of the experiment to analyze the students’ perceptions and experiences in the Tangram puzzle activities and found positive results.

Table 6: Findings from questionnaires

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Usability</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*1. It was difficult to get used to the virtual Tangram puzzle</td>
<td>2.84</td>
<td>0.8</td>
</tr>
<tr>
<td>2. It was easy to operate the system</td>
<td>3.48</td>
<td>1.05</td>
</tr>
<tr>
<td>3. I was not stuck in the process of using the system</td>
<td>3.76</td>
<td>0.97</td>
</tr>
<tr>
<td><strong>Strategies in problem solving</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. I would like to piece the puzzle after the discussion with my partners</td>
<td>3.92</td>
<td>1.00</td>
</tr>
<tr>
<td>5. I would like to sketch the shape in advance</td>
<td>4.20</td>
<td>0.76</td>
</tr>
<tr>
<td>6. I would scrabble the puzzle after deep thinking</td>
<td>4.04</td>
<td>0.79</td>
</tr>
<tr>
<td>7. I would ask for help from my partners if I encountered difficulties</td>
<td>3.88</td>
<td>0.78</td>
</tr>
<tr>
<td>8. I would keep trying new patterns</td>
<td>4.16</td>
<td>0.69</td>
</tr>
<tr>
<td><strong>Engagement</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. I felt well engaged in those activities</td>
<td>4.48</td>
<td>0.82</td>
</tr>
<tr>
<td>10. I would try my best to complete the puzzle with the discussion with my partners</td>
<td>4.36</td>
<td>0.76</td>
</tr>
<tr>
<td>11. I would give as much feedback as possible to my partners</td>
<td>4.40</td>
<td>0.71</td>
</tr>
<tr>
<td>12. I would try my best to get the goals of our group</td>
<td>4.40</td>
<td>0.71</td>
</tr>
<tr>
<td><strong>Learning activities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. My partners and I were easy to reach a consensus</td>
<td>3.48</td>
<td>1.09</td>
</tr>
<tr>
<td>*14. My partners were not willing to discuss with me</td>
<td>2.48</td>
<td>1.12</td>
</tr>
<tr>
<td>15. My partners and I gave each other feedback</td>
<td>4</td>
<td>0.81</td>
</tr>
<tr>
<td>16. I had learned more knowledge about the geometric graphics</td>
<td>4.16</td>
<td>0.85</td>
</tr>
<tr>
<td>17. I could complete the puzzle shapes together with my partners</td>
<td>4.40</td>
<td>0.76</td>
</tr>
<tr>
<td>18. I could successfully complete the shape that I want</td>
<td>3.92</td>
<td>0.91</td>
</tr>
<tr>
<td>*19. It had no help in my learning</td>
<td>2.08</td>
<td>1.12</td>
</tr>
<tr>
<td><strong>Motivation and interest</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. It was more interesting to piece the puzzle with my partners</td>
<td>4.12</td>
<td>0.83</td>
</tr>
<tr>
<td>21. I found it quite interesting to play virtual Tangram puzzle</td>
<td>4.40</td>
<td>0.82</td>
</tr>
<tr>
<td>*22. I found it easier to play the Tangram puzzle by my self</td>
<td>2.84</td>
<td>1.14</td>
</tr>
<tr>
<td>23. I liked to discuss problems with my classmates</td>
<td>3.96</td>
<td>0.68</td>
</tr>
<tr>
<td>24. I would like to have another play, managing other shapes</td>
<td>4.52</td>
<td>0.87</td>
</tr>
<tr>
<td>25. I hope we can have more activities like this in our Math class</td>
<td>4.24</td>
<td>1.17</td>
</tr>
</tbody>
</table>

(1) Usability: The mean of Question 1 and Question 2 are 2.84 and 3.48 respectively. Only 12% of the students were not familiar with the touch pen and it took time for them to get used to. During the post-interviews that followed, the students complained that their peers in other group move their Tangram puzzle in the process. We should consider it as a point to improve the system.

(2) Strategy in problem solving: All students had applied different strategies such as problematical thinking, trial and error, and peer help searching to achieve their goal except differed in ways of discussion.

(3) Engagement: Students were very engaged in puzzle piecing and could help each other. More than 80% of the students held positive view to collaborative puzzle shaping and struggled for the goal.
(4) Learning activities: Some groups lacked collaborative skills which had resulted in conflicts. 20% of the students felt being isolated or not being able to communicate with their group mates whenever a particular group member started dominating the group. However, 76% of the participants believed that playing virtual Tangram would stimulate more idea exchange and interaction with their group mates. In general, over 70% of students could complete the puzzle shapes and enhance their understanding of geometric graphics. Over 90% of the students could reach the goal through collaboration despite that 12% of them were less actively engaged in the activities and held negative views.

(5) Motivation and interest: More than 70% of the participants stated that they liked to work with their group mates to solve problems. Over 80% of them anticipated alternative challenge of puzzle shaping and expected more interesting collaborative activities like that. This indicates their strong willingness of learning through playing the tangram and consequently they were fully motivated to learn.

Findings from the interviews

Semi-structured interviews were conducted to investigate the student experience and perceptions in collaborative problem solving with puzzle piecing as well as the process of learning. The findings from the interviews are analyzed from three perspectives. (NB: ‘Gx’ represents the group and ‘Sxx’ represents the student)

Impact of collaboration in problem solving: The group strategy to ask children to challenge jigsaw puzzle as a group demonstrated that in the cooperative process of discussion and sharing students also created and exchanged ideas, had their group work skills improved through interaction, thereby had promoted the motivation and interest of learning.

“Everybody could think together, which may contribute to the understanding of Tangram puzzle” (G2-S9)

“We carried out group discussions if we couldn’t work it out” (G6-S20)

“We knew more ways of puzzle piecing” (G1-S23)

“We could distribute the work and reach the goal with collaboration” (G2-S9)

“It is more interesting to play the Tangram puzzle with others than to play all by myself” (G6-S20)

Learning experience: Playing Tangram puzzle collaboratively allows students to obtain empirical experiences. Students held positive views to the cooperative Tangram puzzle. They claimed that they could play puzzle with group members easily and which is more interesting than individuals. But some of the students had difficulty to use the touch pen, which get in the way to organize and compose the shape freely.

“It deepened the impression with the practical operation” (G6-S6-23)

“We could stop anytime where necessary by using computers and keep going after full understanding” (G5-S7)

“I was engaged to play the Tangram puzzle with my classmates and discuss how to solve the problems” (G1-S16)

“Very interesting, I want more Tangram puzzle” (G2-S9)

“The touch pen is not easy to handle. I hope I can use the mouse instead” (G5-S21)

Learning Gains: By rotating and moving each piece of the Tangram puzzle, it helps students to understand the geometry and size composition. Not only can review students’ previous mathematics knowledge but also stimulate their imagination.

“I gained a better understanding in geometric graphics after playing the Tangram puzzle” (G6-S20)

“I understood the size of the dismantling and the composition and decomposition of graphics” (G7-S4)

“It helped to understand the approaches of calculation” (G7-S4)

“It helped to develop my imagination by scribbling” (G2-S9)

CONCLUSIONS

In this study, a 1:1 digital learning environment for computer supported collaborative learning was facilitated to the students for learning geometric concepts. Each student was given equal opportunity to operate the system for developing the geometric spatial sensing and reasoning skills. The researchers argued that the collaborative learning activity of virtual Tangram could reduce the gap between high-ability and low-ability students. The empirical operation could help in understanding the composition of area and stimulate the imagination and creativity. What’s more, the collaborative virtual learning tool enabled resource sharing and formed the interdependent learning environment. Partners in the group can help each other by thinking together, discussing and giving each other feedback. They also learned how to negotiate with their partners and had their confidence strengthened to problem solving with better motivation and interest.

The findings of this research could be possible reference for relevant research and practices while some further
Suggestions need to be addressed as below:

1. Expand the sample of target group and set up control group for further research.
2. Prolong the implementation and enable sufficient time for exercises.
3. Add more projectors to each group or the space of public board to promote face-to-face interaction.
4. Methods of mixed heterogeneous grouping can promote students learning with different ability to learn from each other and solve problems collaboratively.
5. The teacher should train students and develop their group work skills.
6. The teacher should encourage all students to participate in the activity and overcome difficulties with time scheduling and multi-resources of groups.

REFERENCES
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THE IMPACTS OF MATHEMATICAL REPRESENTATIONS DEVELOPED THROUGH WEBQUEST AND SPREADSHEET ACTIVITIES ON THE MOTIVATION OF PRE-SERVICE ELEMENTARY SCHOOL TEACHERS

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ABSTRACT
The purpose of this study was to compare the influence of instruction using WebQuest activities with the influence of an instruction using spreadsheet activities on the motivation of pre-service elementary school teachers in mathematics teaching course. There were a total of 70 pre-service elementary school teachers involved in this study. Thirty of them were included in the group that developed WebQuests and forty of them were included in the group that did spreadsheet activities during the seven weeks of mathematics instruction. The researchers used a Likert-type questionnaire consisting of thirty-four positive and negative statements as pre-and post-tests to find out the motivational attitudes of the participants towards using technology in mathematics teaching course. After the collection of the data, the researchers used the independent samples t-test and ANCOVA to analyze the quantitative data. The study documented that although there was a statistically significant difference found between the mean scores of the groups on the pre-test favoring the one who did spreadsheet activities, the results of the ANCOVA indicated that developing WebQuests had more positive influence on the motivation of the pre-service elementary school teachers than doing spreadsheet activities in mathematics.

Key Words: WebQuest; spreadsheets; motivation; mathematics; pre-service teachers

INTRODUCTION
Research has shown that the use of technology plays prominent roles in teaching and learning in all educational areas (e.g., Schofield, 1995; Hardy, 1998; NCTM, 2000; Drier, 2001; Olkun, Altun & Smith, 2005; Freitas & Jameson, 2006; Hassanien, 2006; Lin, 2008a; Chang & Tseng, 2009). Therefore, students should be aware of the technology around them and be able to use them appropriately (Hunt, 1995). Moreover, Drier (2001) claimed that studies in teacher education have underlined the importance of learning with technology rather than learning about technology.

Technology is essential in teaching and learning mathematics. National Council of Teachers of Mathematics (NCTM) (2000) stated that the technology influences the mathematics teaching and students’ learning. The use of technology in instruction has the potential to change both the teaching and the learning of mathematics. The computers with appropriate software transform the mathematics classes into laboratories much like the environment in many science classrooms, where the learners use technology to investigate, conjecture, and verify their findings. In this environment, the teacher encourages experimentation and gives opportunities for learners to summarize ideas and establish connections with previously studied topics (NCTM, 1989). Furthermore, computer technology is changing the ways we use mathematics; consequently, the content of mathematics programs and the methods by which mathematics is taught are changing. Besides, students should continue to study mathematics based on their level, and they also should be able to recognize when and how to use computers effectively when doing mathematics. Therefore, mathematics teachers should be able to appropriately use a variety of computer tools such as, geometer’s sketchpad, spreadsheets, and so forth, and utilize the Internet as a resource in the mathematics classrooms (e.g., Dodge, 2001; Sharp, 2003). In particular, the use of computers with well-prepared educational software would enhance teaching and learning. Furthermore, using technology in teaching and learning has great effects on students and pre-service teachers’ motivation and achievement in mathematics (e.g., Schofield, 1995; Halat, 2008a/2009; Lin, 2008b).

There are many factors such as, anxiety, gender, instruction, teacher-care, peer interaction, parental support, environment, use of technology, and so on seeming to play vital roles on the student motivation and achievement in mathematics (e.g., Schofield, 1995; Freitas & Jameson, 2006; Wei & Chen, 2006; Halat, 2008a). According to
Middleton (1995), real-life activities, group practices and hands-on activities are important factors that greatly affect student motivation towards mathematics. Likewise, Stipek (1998) and Middleton and Spanias (1999) claimed that well-structured instructional design including clear and meaningful task activities positively influences student achievement and motivation in mathematics. Moreover, Lin (2008b) stated, “Students with a high level of computer competency tended to feel less anxious, and more confident than students with a low level of computer competency toward using computers and Internet resources in teaching mathematics” (p.11). Peker & Halat (2009) expressed that designing WebQuests caused a decline in the teaching anxiety levels of the pre-service teachers more than doing spreadsheet activities in mathematics. Halat (2008a) also claimed that the ones who designed the WebQuests showed positive attitudes towards mathematics course than the ones who did the regular course work. Therefore, in this study the researchers tried to compare the impacts of instructions that include doing spreadsheet activities and developing WebQuest-based applications in mathematics on the motivation of the pre-service elementary school teachers.

**Research about the Use of Spreadsheets & WebQuests in Mathematics**

There can be many research studies found involving the use of spreadsheets in mathematics teaching and learning. During the last two decades, spreadsheets have been used in teacher education and K-12 classrooms to explore a variety of mathematical concepts and to help students use numerical and graphical methods to solve problems (Bright, 1989; Edwards & Bitter, 1989; Baki, Tiryaki, Celik, & Oztok, 2000; Cinar & Ardahan, 2003, Dede & Argun, 2003; Andrews, 2003; Isiksal & Askar, 2005). These researchers believe that spreadsheets offer the potential to encourage students to explore and express mathematical ideas that they are likely to use when solving problems.

The spreadsheets can help students move from specific examples to generalized relationships. According to Sharp (2003), one of the beauties of using spreadsheets is that it is possible to set up calculations, change some cell values and look at the effect on the results immediately. Today, it is clear that educational research supports the use of spreadsheets both in teacher education and K-12 classrooms.

There are many benefits of using spreadsheets. For example, the spreadsheets allow students to talk about essential mathematical concepts without using algebraic notation. According to Edwards and Bitter (1989), the students can answer a variety of questions based on one problem and see the relationships among the variables as number change. The spreadsheets allow mathematical concepts to be illustrated through concrete and numerical examples (Neuwirth, 1996). Moreover, Sgroi (1992) claimed that it allows the students to apply a variety of mathematics skills, both thinking and computing. The spreadsheets build an ideal bridge between arithmetic and algebra and allow the student free movement between the two worlds (Friedlander, 1998).

One of the rapidly emerging uses of the Internet is web-based activities (e.g., Wei & Chen, 2006). Dodge (1995) defined a WebQuest as “an inquiry-oriented activity in which some or all of the information that learners interact with comes from resources on the Internet”. WebQuest has become prominent in many educational areas and has received considerable attention from teachers and educators since it was proposed and developed by Dodge (e.g., Yoder, 1999; Kelly, 2000; March, 2000; Zheng, Perez, Williamson, & Flygare, 2008). Besides, the WebQuests as an alternative instructional technique has already been widely adopted and practiced in K-16 education (Zheng et al., 2008; Halat, 2009).

According to Schofield (1995), the use of technology in teaching and learning has positively influence the motivation and achievement of students. Likewise, Wei and Chen (2006) argued that the Internet has a great impact on both students and teachers. It must also be remembered that although the web has a lot of valuable information, it is also full of useless information. The misuse of the Internet concerns parents, educators, administrators, teachers and others (Mason, 2000). Dodge (2001) proposed and developed a WebQuest model, new teaching & learning technique, which uses the Internet in the classroom and meets the concerns of those expressed above. Besides, several research studies showed that an instruction that uses WebQuest-based applications in the classrooms had positive effects on students’ attitudes toward mathematics learning (Halat & Jakubowski, 2001; Halat, 2007). Likewise, Peker & Halat (2009) examined the impacts of mathematical representations developed through WebQuest and spreadsheet activities on the teaching anxiety level of the pre-service elementary school teachers in mathematics and found that developing WebQuest activities reduced the teaching anxiety levels of the pre-service teachers more than doing spreadsheet activities in mathematics.

According to Halat (2008b), the followings are the strengths of WebQuests: “Is an alternative teaching technique that enhances students’ motivation in class; Serves as an alternative assessment tool of student’s learning; Gives teachers an idea of the students’ degree of acquisition of knowledge and implementation of the knowledge; Provides teachers an opportunity to see and assess students’ ability in using technology for learning; Enhances...
teachers’ creativity in thinking and writing, such as finding interesting and funny stories or scenarios and combining these with math or other subjects; Enhances teachers’ higher-order thinking skills, such as finding topic-related Web sites and examining and selecting professional, well-prepared, and reliable Web sites; Requires students to be active learners; Allows students to use Internet as an important tool” (p.10). Furthermore, Zheng et al. (2008) identified three critical constructs of WebQuests, constructivist problem solving, social interaction and scaffolded learning, based on the teachers’ perceptions. Moreover, their study indicated that the variables, such as years of WebQuest use, purpose of WebQuest use, years of teaching, and gender predicted, at various levels, the perceptions of teachers on WebQuests. They suggested that “the purpose of WebQuest use, that is, how and for what purpose one would like to use the WebQuest, is critical in influencing teachers’ perceptions and consequently their implementation of WebQuests in teaching and learning” (p.302). They also added, “teachers’ perceptions on constructivist problem solving, which in essence reflect an epistemological thinking in learning, are affected by their years of teaching and years of WebQuest use” (p.302).

**The purpose of this study**
The study focused on the use of technology in mathematics teaching and learning, and the effects of it on the motivation of the pre-service primary school teachers. In particular, the researchers searched for the answer of the following question:

Q: Is there a difference, if any, with respect to motivation between the pre-service elementary school teachers who designed WebQuest-based applications and the pre-service elementary school teachers who did spreadsheet activities in mathematics teaching and learning?

**METHOD**

**Methods of Inquiry**
The researchers followed the quasi-experimental statistical design procedure in the study. With this procedure the control group was compared with the experimental group, but participants were not randomly selected and assigned to the groups (Creswell, 1994; McMillan, 2000). According to Creswell (1994), the nonequivalent (Pretest and Posttest) control group design model is a popular approach to quasi-experiments. In this study, while the experimental (treatment) group included students who were required to design their WebQuests, the control group comprised students who were required to do spreadsheet activities in the classroom.

The experimental research method was chosen by the researchers because of the fact that “it provides the best approach to investigating cause-and-effect relationships” (McMillan, 2000, p. 207). In the study pre-test and post-test were given to the participants before and after the instruction as an independent variable. The researchers investigated the influences of doing both spreadsheet and WebQuest activities on the pre-service primary school teachers’ attitudes towards the mathematics teaching course. The comparison of students’ motivational levels was made in the study. Therefore, this experimental approach enabled the researchers to evaluate the effectiveness of developing both spreadsheet and WebQuest-based applications in mathematics classroom.

**Participants**
In this study the researchers followed the “convenience” sampling procedure defined by McMillan (2000), where a group of participants is selected because of availability. There were a total of 70 pre-service elementary school teachers, 30 in experimental group and 40 in control group, involved in this study. Participants in the study were pre-service elementary school teachers enrolled in mathematics teaching course at a university located in central Turkey. The study was conducted during the spring semester of 2008, and it took place seven weeks. Each group had four hours of instruction in a week.

**Data Sources**
The researchers used a questionnaire, Course Interest Survey (CIS), in the collection of the data. It was used as pre-test and post-test in the study. The questionnaire Course Interest Survey (CIS) taken from Keller’s (1999) work includes thirty-four statements categorized into four parts, Attention, Relevance, Confidence and Satisfaction. Using a Likert-type rating scale including statements, some positive and some negative, relating to the attitude being measured, this questionnaire was administered to the participants for 20 minutes. The course interest survey is designed to evaluate a situational measure of students’ motivation in a specific classroom setting. The goal with this instrument is to investigate how students are motivated, or expected to be, by a particular setting. In the study, participants in both groups met for four hours of instruction in a week for a semester.
The following statements are taken from the Course Interest Survey (CIS) in order to give the readers some idea about the questionnaire; “The instructor knows how to make us feel enthusiastic about the subject matter of this course”, “I feel confident that I will do well in this course”, “This class has very little in it that captures my attention”, “I have to work too hard to succeed in this course”, “I feel that this course gives me a lot of satisfaction”, “In this class, I try to set and achieve high standards of excellence”, “The students in this class seem curious about the subject matter”, “I enjoy working for this course”, “The instructor does unusual or surprising things that are interesting”, “My curiosity is often stimulated by the questions asked or the problems given on the subject matter in this class”, “I feel that I get enough recognition of my work in this course by means of grades, comments, or other feedback”, “I get enough feedback to know how well I am doing”.

Instructional Procedures
The researchers conducted this study in a mathematics teaching course requiring problem solving and writing based on major mathematical concepts at their levels, such as operations, fractions, numbers, measurements and so on, developing teaching methods and materials that are appropriate to elementary school students from 1st grade to 5th grade, and learning how to teach certain topics in mathematics. These were the main tenets of the course offered to the students at the Department of Elementary Education. In addition to these requirements, whereas the participants who were in the experimental group were required to design WebQuest-based applications as an individual project, the others who were in control group were required to develop spreadsheet activities.

Procedures of WebQuests Designing and Developing Spreadsheet Activities
At the beginning of the study, the pre-service elementary school teachers in the experimental group were introduced a web-page editor, Microsoft FrontPage, taught the components of a good WebQuest, and showed how to design one. After becoming familiar with the structure and preparation of a WebQuest, the participants worked themselves and chose one of the topics in mathematics, such as numbers, operations, fractions, three-dimensional figures, volume, quadrilaterals, triangles, area, perimeter, and so on under the guidance of the researchers. Each student wrote his/her scenarios or adapted cartoon movies, such as Casper, Shrek, Ice-Age, Alice Birthday Party, Treasure Island, and so on to a math topic that s/he chose. Furthermore, the participants in the experimental group designed their teaching materials that were appropriate for elementary school level students. Then, all participants searched on the Internet to find reliable websites to fulfill their needs. After the collection of all necessary resources and materials, each participant designed his/her WebQuest portal on which students were supposed to follow the given instructions and complete the assigned tasks to learn the topic. After the process of designing WebQuests, the pre-service elementary school teachers in the experimental group presented their WebQuests in 5-10 minutes in the class.

Likewise, at the beginning of the study the participants in the control group were given information and shown how to use Microsoft Excel and do some spreadsheet activities in the computer lab. In particular, they were required to create spreadsheets about mathematics that were appropriate and useful for the elementary school students. For example, they developed spreadsheets that find the perimeters and areas of triangles and quadrilaterals, and check whether it constructs a triangle or a quadrilateral with the given lengths or angles. They also developed spreadsheets that helped them solve routine and non-routine mathematical problems such as, magic squares (3x3), head and feet problems of animals, and so forth. After seven weeks of instruction, each student made 5-10 minutes presentation to the class.

Test Scoring Guide for the Course Interest Survey (CIS)
The researchers followed the Keller’s (1999) test scoring guide in the analysis of the CIS. The response scale ranges from 1 to 5. According to this scale, the minimum score is 34 on the 34-item survey, and the maximum is 170 with the midpoint of 102. The minimums, maximums, and midpoints vary for each subscale because the numbers of item distributions are not the same as shown below. Keller (1999) also gives an alternative scoring method that is to find the average score for each subscale and the total scale instead of using sums. For each respondent, divide the total score on a given scale by the number of items in that scale. This converts the totals into a score ranging from 1 to 5 and makes it easier to compare performance on each of the subscales. He noted, “Scores are determined by summing the responses for each subscale and the total scale. Please note that the items marked reverse are stated in a negative manner. The responses have to be reversed before they can be added into the response total.

Data Analysis
In the analysis of the data, first the researchers conducted the independent-samples t-test statistical procedure with \(\alpha = 0.05\) on the pre-service elementary school teachers’ pretest scores from CIS to determine any differences in terms of motivational level between experimental and control groups. This t-test procedure
showed means score differences in terms of levels and motivation between the two groups favoring the control group. Then, scores from the CIS were compared using one-way analysis of covariance (ANCOVA) with \( \alpha = 0.05 \), which is a variation of ANOVA, to adjust for pretest differences that existed between control and experimental groups. “For instance, suppose in an experiment that one group has a mean value on the pretest of 15 and the other group has a pretest mean of 18. ANCOVA is used to adjust the posttest scores statistically to compensate for the 3-point difference between the two groups. This adjustment results in more accurate posttest comparisons. The pretest used for the adjustment is called the covariate” (McMillan, 2000, p. 244). In other words, because of the initial differences with reference to the participants’ motivational levels between the groups, ANCOVA was used to analyze the quantitative data in the study. The pretest scores from the Course Interest Survey served as the covariates in the analysis of participants’ motivation by WebQuests and spreadsheet activities. ANCOVA enabled the researchers to compare the motivation level of each group.

**RESULT**

Q: Is there a difference, if any, with respect to motivation between the pre-service elementary school teachers who designed WebQuest-based applications and the pre-service elementary school teachers who did spreadsheet activities in mathematics teaching and learning?

Table 1 displays the descriptive statistics for the pre-service elementary school teachers’ motivation based on the CIS scores, and indicates that there is a change in the participants’ motivational levels between pre- and posttest scores for both groups. Whereas there was an increase between the pre-and post-test scores in the motivational level of the participants in the experimental group, there was a decline in the motivation of the participants in the control group. The mean score of the control group on the pre-test (M=130.08) was numerically higher than that of experimental group (M=104.27). However, the mean score of the participants in the control group on the post-test* (M=116.02) was numerically lower than that of the participants in the experimental group (M=126.24) (look at the table 1).

<table>
<thead>
<tr>
<th>Group (Webquest)</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>M</th>
<th>SD</th>
<th>M SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group (Spreadsheet)</td>
<td>40</td>
<td>130.80</td>
<td>14.68</td>
<td>122.50</td>
<td>18.06</td>
<td>116.02</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: a: Covariates appearing in the model are evaluated at the following values: Pre-test = 119.43, *Estimated Marginal Means.

Table 2, however, presents the analysis of covariance (ANCOVA) for both groups so as to the participants’ motivation, and is based on the Course Interest Survey. It demonstrates a significant main impact for the pre-service elementary school teachers who were required to design WebQuest-based applications, \( F(1, 70) = 4.57; p=0.036 < \alpha =0.05 \). In other words, the participants in the experimental group developed WebQuest-based applications outscored the ones who did spreadsheet activities in mathematics teaching and learning.

<table>
<thead>
<tr>
<th>Sources</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean square</th>
<th>F-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>5291.45</td>
<td>1</td>
<td>5291.45</td>
<td>23.54</td>
<td>0.000</td>
</tr>
<tr>
<td>Group</td>
<td>1028.32</td>
<td>1</td>
<td>1028.32</td>
<td>4.57</td>
<td>0.036*</td>
</tr>
<tr>
<td>Total</td>
<td>20764.80</td>
<td>70</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: \( \alpha =0.05, *p=0.036, *p< 0.05 \).

**DISCUSSION & CONCLUSION**

This study showed that designing WebQuest-based applications in teaching and learning mathematics had great effects on the motivation of the pre-service elementary school teachers. This result is not in contrast with the several research findings (e.i., Halat, 2007/2009; Halat and Jakubowski, 2001). For instance, Halat (2008a) found that the students who developed WebQuests displayed more positive attitudes towards mathematics than the others who did not. Similarly, according to Halat and Jakubowski (2001), designing a WebQuest gave the pre-service middle & secondary mathematics teachers an opportunity to practice their mathematics knowledge in a different way, showed them how to adapt technology in their teaching and taught them how effectively the Internet and other programs could be used in the classrooms. They (2001) added, “All groups provided positive responses to wanting to use WebQuests as a break from textbook and traditional ways of teaching” (p. 3).
Furthermore, Schofield (1995) who claimed that using technology in teaching and learning has great effects on students’ motivation, attitudes and achievements. On the one hand, the finding of this study supports the argument of Schofield because of the fact that the participants in the experimental group involved in this study used computer and several software programs, and designed WebQuests that increased their motivational level toward mathematics. But, on the other hand, the result of this study does not agree with claim of Schofield because the pre-service elementary school teachers who were in the control group also used computer and did spreadsheet activities that even caused a decline in the students’ motivation towards mathematics. Doing spreadsheet activities is more about learning and practicing mathematical topics or rules in comparison to designing WebQuests. In WebQuests, students are able to do more mathematical activities and explorations in a game or in a story than just practicing mathematical rules. In other words, developing WebQuest-based activities is more attractive, funny and relaxing, and it is not more traditional in comparison to doing spreadsheet activities. Therefore, it may have caused a considerable increase in the pre-service teachers’ motivation towards mathematics. This also supports the finding of Peker & Halat (2009) who claimed that the ones who developed WebQuests had lower teaching anxiety levels in mathematics than the ones who did spreadsheet activities in the classrooms.

However, the finding of this current study is not lined up with the reports of research (e.g., Eccles & Midlegy, 1989; Gottfried, Fleming, & Gottfried, 2001) claiming that there is a decline in students’ motivation towards mathematics courses. Therefore, WebQuest-based activities either as a group project or a new instructional approach can be used in teaching and learning at college level (Halat, 2007/2009). This supports the claims of Stipek (1998) and Middleton and Spanias (1999) who stated that carefully structured instructional design including clear and meaningful task activities and level of difficulty had a great impact on students’ achievement and motivation in mathematics because WebQuests includes well-designed and meaningful task activities in its structure.

In addition, Middleton (1995) stated that according to the teachers beliefs, doing real-life examples or activities in a mathematics classroom were major motivating factors. He added that it seems that using real-life applications, group practices, hands-on activities, and other strategies played important roles in students’ motivation. Furthermore, he reasoned out, “in general the better teachers were at anticipating the motivational structures of their students, the better they were at providing an environment that facilitated the development of intrinsic motivation” (p.349). This shows that environment is essential to students’ motivation (Stipek, 1998). One of the main tenets of WebQuests is that designers, learners or teachers are supposed to write a scenario or adapt a story related to a math topic that they chose to teach. In other words, the designers of WebQuests include real-life activities in their teaching model, which enhances the participants’ motivation in the study (Halat, 2008a).

Briefly, this study concluded that there was statistically significant difference detected with reference to the motivational level between the experimental and control groups. This was in favor of experimental group. In other words, the ones who designed WebQuest-based applications in a mathematics teaching and learning course indicated better motivational performance than the others who did spreadsheet activities in their course work.

Implications and Recommendations for Practitioners
This current research has several possible implications and suggestions for practitioners. The result of this study implies that developing WebQuest-based activities in a college level method courses may affect more positively the attitudes of the pre-service elementary school teachers towards teaching and learning mathematics than doing spreadsheet activities. Therefore, if the instructors use the technology in their teaching environment, the authors recommend the use of WebQuest-based activities for them in their teaching based on the result of this study. Because developing WebQuest-based activities provides instructors an opportunity to see and assess their students’ ability in the use of technology, enhances the instructors’ creativity in thinking and writing such as, finding interesting and funny stories and combing these with mathematics or other subject areas, and gives the instructors an idea of the students’ level of acquisition of the knowledge and implementation of the knowledge (Halat, 2008b).

Moreover, if the pre-service teachers try to design WebQuest-based activities as a group or individual project in their method courses, they might have an opportunity to practice their pedagogical and content knowledge in a different environment. In addition, developing WebQuest-based activities requires the students to be active learners, and allows the students to enhance higher-order thinking skills, such as finding topic-related Web sites and examining and selecting well-prepared and reliable Web sites (Halat, 2008b).
The finding of this study highlights the importance of National Council of Teachers of Mathematics’ recommendations for teachers and students. NCTM (2000) stated that new educational theories and strategies be implemented in mathematics classrooms. According to Hardy (1998), successful technology adaptation requires careful planning and plenty of time. If the ones find time and carefully plan to work on this technique, they might be successful in the practice of developing WebQuest-based activities in their teaching.

However, both WebQuest and spreadsheet activities would be helpful for students to learn different things in mathematics. WebQuests are exploratory while spreadsheets help learners to determine relationships between variables in mathematical equations or practice mathematical concepts and rules. Although in this perspective doing spreadsheet activities is more conventional than developing WebQuest-based activities, mathematics teachers can use both WebQuests and spreadsheets in teaching for different reasons based on the mathematical concepts.

Limitations and Future Research
Limitations in developing and using WebQuests in teaching and learning include the possibility of lack of access to the Internet, the time spent by the teacher and student to design a WebQuest, and finding reliable links for resources for the WebQuest. Moreover, the findings of this current study should not be generalized to all pre-service teachers because this is not a pure-experimental study. This is a quasi-experimental study. With this research design the control group was compared with the experimental group, but participants were not randomly selected and assigned to the groups. Therefore, this research design limits the findings of the study.

There is enough support to encourage the further research studies of the use of WebQuests in Teacher Preparation Programs and the implementation of WebQuests in the middle and high school classrooms. According to Halat (2008a), designing WebQuest-based activities enhances the motivation of the pre-service elementary school teachers towards mathematics. This supports the finding of this current study. Therefore, although this study included the pre-service elementary school teachers as participants, future research can be done with others who are in different Teacher Education Programs such as, geography, linguistics, history, mathematics, biology, physics, chemistry, and so far. This sort of studies might be also done with high school students. In addition, the researchers examined the effects of the WebQuests and Spreadsheets on the pre-service elementary school teachers’ motivation in mathematics. Therefore, the future research can be done on the other areas such as, social sciences, health, and science.

Furthermore, the researchers might investigate the influence of the in-class implementation of the WebQuests on the middle and high school students’ motivation and achievement. WebQuests, when done successfully, can be meaningful teaching strategies that utilize student use of technology in the classroom. This is in agreement with the claim of Freitas and Jameson (2006) argued that the ways in which technological developments can and do contribute to increased successful learning outcomes.

REFERENCES


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THE USE OF SMS SUPPORT IN PROGRAMMING EDUCATION

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ABSTRACT

The rapid developments in the communication technologies today render possible the use of new technological support tools in learning processes. Wireless, or mobile wireless, technologies are the tools whose potential contributions to education are investigated. The potential effects of these technologies on learning are explored through studies where either the entire learning process is carried out via mobile learning practices or the mobile tools are used as support tools in a mixed learning environment. In this study, the possible uses of mobile phones, which have a large user potential among mobile technologies, as support tools in the programming language education process have been analyzed. During the study that has been carried out via the Short Message Services (SMS) of mobile phones, lists of the messages sent to the students have been recorded and it was observed at the end of the application process that the SMS support had influenced the students’ academic achievements significantly.

Keywords: Communications technology, Short Message Services (SMS)

INTRODUCTION

It is observed that most definitions of the mobile technologies are synonymous to the wireless systems. However, there exist important points that these two concepts differ from each other. Malladi and Agraval (2002) have defined those systems that enable users to connect to a network structure in all environments as mobile systems. On the other hand, Dubendorf (2003) has defined wireless systems as the devices that enable text, audio, video or image contents to be sent through radio waves, infrared radiation or microwaves without any wiring. The distinction between two system structures can be seen through the characteristics in the above definitions. Al-Fahad (2009) referred to mobile phones as mobile wireless systems by combining the above two definitions and defined mobile wireless systems as the devices that use radio waves in order to facilitate the transfer of any kind of data from mobile services to mobile devices, freely from the environment.

The use of mobile wireless systems and especially mobile phones today is very common. According to the data of International Telecommunication Union, the number of mobile cellular network subscribers has increased between the end of 2006 and the end of 2009 by 1.6 billion (ITU, 2010). Especially the mobility in the daily life supports and facilitates the transition to mobile technologies. As for Turkey, a significant change and transformation in years is notable in the characteristics of the use of communication media. This change can be seen in the data of Turkish Information and Communication Technologies Authority (ICTA) (Figure 1).

Figure 1: The Annual Telephone Call Traffics in Turkey
(Source: ICTA, 2010)
According to Figure 1, while a significant difference is notable between the hours of fixed phone calls and mobile phone calls in 2004 in favor of fixed calls, this difference has become reversed in 2009 and mobile phone traffic has increased significantly. According to the 2010 data of ICTA, there exist a total of 61.5 million mobile phone subscribers (ICTA, 2010). Along with this common use of mobile phones, it can be argued that the general way of communication that global mobile phone users prefer is Short Message Services (SMS). SMS is an international messaging system. Asynchronous communication can be established up to 160 characters via SMS that has been used since 1992 (Kert, 2009). Although image and visual communication types are supported via mobile media, SMS communication is used intensely even in the developed countries of the world. For example, according to the data of Ofcom (2010) in England, while the monthly number of SMSs per a mobile phone call is 99, the number of visual communications (MMS) per a phone call is only 0.56. The increase in the use of mobile communication media renders inevitable the examination of the potential effects of these devices on not only the everyday life but also the educational processes.

Numerous researchers have been conducted to investigate the effects of mobile technologies on educational process (Seppala & Alamaki, 2003; Mcconatha, Praul & Lynch, 2008; Aubusson, Schuck & Burden, 2009; Chang, 2008; Al-Fahad, 2009; Gaskell, 2010; Jones, Edwards & Reid, 2010; Kukulska-Hulme & Sharples, 2010; Martines-Torres, Toral, Barrero & Gallardo, 2010; Basoglu & Akdemir, 2010). It can be inferred from these researches' findings that positive effects of these systems are dominant. The mobile learning process can be defined as a new application area, which started to be pedagogically used recently and in which mobile wireless systems are used as supporters of students and teachers in distant learning processes (Mcconatha, Praul & Lynch, 2008), and it can be said that this application area attracts mostly young users (Attewel, 2003). The use of portable, flexible and distributable systems in learning processes has significantly positive effects to individualize the learning (Traxler, 2008). Along with these use advantages, it can be stated that mobile learning systems influence students' motivations and learning levels more positively than the conventional learning methods (Liu, Chu, Tang & Chang, 2007).

The reason of the use of SMS in mobile learning environments can be attributed to the facts that technological requirements are at the minimum level in the use of these environments and it provides easiness in practical application environments. Vavaula and Sharples (2009) have grouped the sharp evaluation of mobile learning process under three headings:

1. Availability of technology
2. Education/Learning level
3. Practical applicability

According to these three headings, the SMS infrastructure differentiates from other mobile systems in terms of accessibility to large masses and ease of use. To what extent these services can contribute to education and learning levels is an application area that needs to be researched according to different course contents.

In this context, the effects of the SMS support, provided to university students' programming education process, on their academic achievements have been investigated and the findings have been analyzed in this study.

METHOD
Context
In this study, the effect of the SMS support in programming education on students' learning levels has been investigated and, within the framework of this main problem, answers to the following sub-questions were sought:

- Are there significant differences between the pretest and posttest scores of those students who received SMS support during the process of programming languages education?
- Is there a significant difference between the posttest scores of the students who received SMS support and those who did not, during the process of programming languages education?

During the study, a process analysis has also been conducted in order to analyze the practical use and the rate of reading the SMSs sent was also recorded.

Participants
The working group of the study consisted of 40 students, who were attending to the Department of Computer Education and Instructional Technologies at Yildiz Technical University in the 2009-2010 Academic Year and taking the course Programming Languages II for the first time. The students were divided into two groups through random sampling, 20 each for the experimental and control groups.
Data Collection Tool
At the beginning of the research process, a pretest prepared by the researcher was administered in order to determine the experimental and control groups' academic achievements. Through this pretest administered to both of the groups, quantitative data were obtained about the academic achievements of both groups. While the experimental and control groups were continuing their standard education, the experimental group was provided with SMS support in this process. The achievement test, which had been administered to both groups as pretest at the beginning of the research, was administered again as posttest. This way, quantitative data were obtained both about the groups' individual achievement scores and about the difference between their posttest achievement scores.

Pre-Application Preparation
Forty participants who took the Programming Languages II course for the first time were divided into two groups through random sampling, 20 each for the experimental and control groups. In order to control the balance between the groups, the academic achievement test was administered to both groups as pretest and if there existed a significant difference between the groups' academic achievement scores was tested. In order to control the difference between the academic achievement scores, t-test analysis was carried out and the analysis results are given in Table 1.

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Mean(X)</th>
<th>Standard Deviation</th>
<th>df</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>20</td>
<td>8,10</td>
<td>4,29075</td>
<td>38</td>
<td>-037</td>
<td>.971</td>
</tr>
<tr>
<td>Control Group</td>
<td>20</td>
<td>8,15</td>
<td>4,20870</td>
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</table>

Table 1 demonstrates that there is not any significant difference between the pretest achievement scores of the experimental and control groups (t: -.037; p>.05). It can thus be concluded that the balance between the academic achievements of the groups was ensured before the application.

Application Process
During the application process of a total of seven weeks, information messages through SMS were sent to the experimental group in parallel with the course content of Programming Languages II. In this process, a total of 27 SMS messages were sent throughout seven weeks. All sent messages were approved through the mobile service that they were delivered to the experimental group. Moreover, randomly produced special code words were placed at the ends of each SMS messages in order to discover if the students read the sent SMS messages entirely or not, and the students were asked to send these code words back to the telephone number from which the message had been sent. The record of students' sending the code words back during the process is listed in Table 2.
Table 2: The SMS Messages Sent to the Participants throughout the Application Process and the Read Receipts Returned

<table>
<thead>
<tr>
<th>SMS Nr</th>
<th>Participant Nr</th>
<th>Returned</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
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<td>2</td>
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<td>26</td>
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<td></td>
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<tr>
<td>27</td>
<td></td>
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</tr>
</tbody>
</table>

Table 2 indicates that some students did not respond to some messages. Students pointed out that they did not have enough time to respond to the messages sent. Code words were later received via e-mail from those students who had not sent the code words via SMS. Through these code words, it was attempted to control whether the students really read the messages they received. Messages were sent at different hours of weekdays in order to ensure that the time difference during the day would not affect the research findings. In order to maintain the group balance, all information messages sent to the experimental group via SMS were given to the students in the control group as a written document in the final week of the application process.

**FINDINGS**

After the application process, the academic achievement test, which had been administered to the experimental and control groups as pretest, was administered to both groups again as posttest. Independent groups t-test was conducted to compare the groups' posttest scores, and the paired-samples t-test was conducted to examine the difference between both groups' in-group pretest and posttest scores. The data were analyzed through the SPSS software.

Firstly, if there existed a significant difference between the pretest and posttest academic achievement scores of the students in the experimental group was tested, and analysis results are presented in Table 3.

Table 3: Paired-Samples T-Test Results for the Experimental Group's Pretest and Posttest Scores

<table>
<thead>
<tr>
<th>Control Group</th>
<th>N</th>
<th>Mean (X)</th>
<th>Standard Deviation</th>
<th>df</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>20</td>
<td>8.10</td>
<td>4.29075</td>
<td>19</td>
<td>-17.889</td>
<td>.000</td>
</tr>
<tr>
<td>Posttest</td>
<td>20</td>
<td>23.30</td>
<td>2.31926</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3 demonstrates that the posttest achievement scores of the experimental group are significantly higher than its pretest achievement scores (t=-17.889; p<.05). Then, if there existed a significant difference between the pretest and posttest academic achievement scores of the students in the control group was tested, and analysis results are presented in Table 4.

<table>
<thead>
<tr>
<th>Control Group</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>df</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>20</td>
<td>8.15</td>
<td>4.20870</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>20</td>
<td>19.85</td>
<td>4.50614</td>
<td>19</td>
<td>-11.880</td>
<td>.000</td>
</tr>
</tbody>
</table>

Table 4 demonstrates that the posttest achievement scores of the control group are significantly higher than its pretest achievement scores (t=-11.880; p<0.05). At the end of the research process, the difference between the posttest academic achievement scores administered to the experimental and control groups was tested through independent groups t-test and the results are presented in Table 5.

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Mean(X)</th>
<th>Standard Deviation</th>
<th>df</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>20</td>
<td>23.30</td>
<td>2.31926</td>
<td>38</td>
<td>3.067</td>
<td>.005</td>
</tr>
<tr>
<td>Control</td>
<td>20</td>
<td>19.85</td>
<td>4.46360</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5 indicates that there exists a significant difference between the posttest academic achievement mean scores of the experimental and control groups (t=3.067; p<.05). In this respect, it can be stated that the SMS support provided to the students in the experimental group has improved their learning performances positively.

CONCLUSION

Wireless mobile technologies are the tools whose uses are becoming widespread day by day within the mobility of the daily life. It is considered to be necessary to consider the use of mobile phone separately among these technological tools due to its vast popularity and its flexible characteristics of use. In this study, an example was attempted to be presented about the ways the content of a technical course can be supported through SMS that is notable with its important use features among mobile phone applications, and the findings were analyzed. Although there exist new generation mobile phones with much more developed multimedia features, it was determined and approved during the research that SMS messages can be used by all users and for all mobile phones without technological limitations. Firstly, the in-group pretest-posttest results of the two groups that had received SMS support and not were analyzed, and it was observed that there existed significant differences in favor of both groups’ posttest achievement scores. This finding indicates that the learning process had been useful for both of the groups.

Following the in-group controls, the posttest academic achievement scores of the group that had received SMS support and the group that had not were compared in order to be able to make comparisons between groups, and it was determined that the posttest academic achievement scores differentiated in the favor of the group that had received SMS support. This finding suggests that SMS support can be used as a support tool in learning process, given the fact that all the content given to the experimental group via SMS was also presented to the control group as a written document. This finding supports the findings of the studies conducted by Martines-Torres, Toral, Barrero & Gallardo (2010) and Echeverria, Nussbaum, Calderon, Bravo, Infante and Vasquez (2009). Besides, Jones, Edward and Reid (2010) obtained similar findings regarding the use of SMS in the role of a support tool for university students.

In light of the findings obtained as a result of the study, it is believed that further studies that will focus on the contributions of wireless technologies and mobile phones to learning processes can test the multimedia features of especially mobile phones such as Podcast, Vodcast etc., and investigate the effects of these media on different course contents.

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REFERENCES
TURKISH EFL ACADEMICIANS’ PROBLEMS CONCERNING TRANSLATION ACTIVITIES AND PRACTICES, ATTITUDES TOWARDS THE USE OF ONLINE AND PRINTED TRANSLATION TOOLS, AND SUGGESTIONS FOR QUALITY TRANSLATION PRACTICE

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ABSTRACT
This mixed method research study aimed to highlight the problems of EFL academicians concerning their current translation practices, their attitudes towards the use of various translation tools, and offer suggestions for more quality translation practices. Seventy-three EFL academicians from three Turkish universities participated in the study. The qualitative data was collected through semi-structured interviews and open-ended questionnaire items and analyzed with the content analysis while the quantitative data was obtained through Likert–scale items and analyzed with descriptive statistics. Based on the participants’ ideas, the establishment of a translation center in the university, collaboration with professional translators with academic background and experience of professional translation in various disciplines, the organization of awareness-raising seminars, the introduction of minor and double major programs in translation and the integration of training programs facilitating the use of online translation tools and search engines were found beneficial in enhancing the quality of existing translation practices.

Keywords: computer-aided translation, ELT, terminology, online tools

INTRODUCTION
The communications revolution – computers, the internet, satellite communications – which was strategically deployed as central to the process of globalization, followed the lead of English-language teaching theory and accompanied the layout of theoretical and pedagogical grounds for Communicative Language Teaching (CLT) (Cubukcu, 2010). Therefore, English language teaching has had the opportunity to use such an advantage. However, as regards the translation’s contribution to communication, it was still necessary to wait for the development of the search engines and user friendly online tools to have the instant and cost effective access to the corpora we can use to understand the language system and reach a stylistically and structurally accurate equivalence between languages. This kind of access to information also meant the collapse of cultural and linguistic barriers between countries.

The global market requires that industrial and commercial issues be negotiated on an international scale. Within this global landscape, nations maintain and strengthen their cross-cultural bonds. Nevertheless, they also wish to preserve their independence and cultural identity. According to Çubukçu (2010, p. 98), command of English, which has become a dominant global language of communication, business, industries, entertainment, diplomacy, politics, science and the Internet, empowers those who have already acquired this lingua franca. It is the opinion of the authors of this article that translation may serve to cover the gap between the empowered and those who are left behind as regards the command of such a dominant language, and may prevent the possible danger, which Cubukcu (2010) has mentioned, of loss of first languages, cultures and identities and devaluation of local knowledge and cultures. On the other hand it is a skill – the fifth skill, according to Köksal (2005) – that can be incorporated into ELT methods or approaches.

A rise has been noted recently in the popularity of the profession of translation, manifested through a subsequent increase in the number of academic institutions offering translation programs to train prospective translators (Sanchez, 2006). Sanchez also mentioned recent studies dealing not only with trainees’ translation competence but also the market demands (e.g. Muňoz Martín, 2002; Pym, 2003; Reineke and Sánchez Muňoz, 2005; Rico Pérez, 2002; cited in Sanhez: 2006), which is likely to have some significant repercussions on the professional practices.

The importance of English can not be underestimated. Craciunescu, Gerdin-Salas, Stringer-O’Keeffe (2004) underlined its first place in the translation market with 48% as a source language and 45% as a target language. Besides, Fletcher (2005) stated that the two thirds of the content indexed is English-language documents according to data from large search engines such as google, yahoo, msn, and teoma. Thomas (1996: cited in
Alptekin, 2002) emphasized that the storage was in English for the eighty percent of the computer data and the eighty five percent of all information. However, as Craciunescu et al. (2004) has emphasized, there is a lack of professional translators to meet the huge demand for translation in multifarious scientific disciplines.

Translation is a complicated process that requires a thorough command of the source and target language in terms of their syntactic, semantic and pragmatic properties, in addition to a great deal of creativity and imagination. Machine translation (MT) is regarded as inefficient, inaccurate and inappropriate, with its output capacity limited to simple texts and controlled language, especially in terms of the literary text translation. The issues such as polysemy, connotation and style remain to be addressed (Sanchez, 2006). MT fails to account for the higher order cognitive operations entailed in the translation process (Craciunescu et al., 2004). Technology cannot replace the human translator; nonetheless, using it wisely can facilitate translation.

As argued by Craciunescu et al (2004) it is widely acknowledged that the professional translator needs to acquire skills related to new technologies to keep his or her efficiency and competitiveness. In search for effective tools to assist the translators, online tools are reported to provide promising solutions (Sanchez, 2006). Biau, Gil and Pym (2006, cited in Sanchez, 2006) also emphasized the vital role of technology in translation in the present era. Korkas, Pavlides, Rogers (2005) argued that a well-trained translator has good research skills, and uses the internet as an extremely useful and powerful research tool, aware of the advantages of the regular update of online dictionaries and encyclopedias and the availability and quick access to the corpora of parallel texts in various domains. Translators or translation trainees use the online resources for terminology challenges presented by increasing specialisation.

Pym (2003) maintained that it is essential to reconsider translation training to meet the requirements of a variety of translation-related contexts in an epoch of whirlwinding technological changes and diversified domains of specialization. Köksal (1995) underscored the need to train translators in the field of technical translation but also conceding that it must be borne in mind that this kind of training only enables translators to specialize in certain areas. Köksal (1995) also put forward an idea that data banks can be formed, and technical terminology dictionaries can be compiled. However, there have not been adequate advances in this regard. The reason might stem from inadequate attention to online products, which are easily available and updated.

Theoretical knowledge of translation makes translators to think of the issues regarding translation in a multidimensional manner (Yazıcı, 2005). Translation competence can be defined as the underlying system of knowledge and skills needed to be able to translate. Its acquisition requires a process of restructuring and developing subcompetencies (communicative, extra-linguistic, professional-instrumental, transfer, strategic and psycho-physiological) the interaction (controlled by strategic competence) and hierarchy (related to transfer competence) of which vary according to directionality and language combinations, specialisation or translation context (Beeby, Berenguer, Ensinger, Fox, Albir, Mélis, Neunzig, Orozco, Presas, and Vega, 2000). Special subject knowledge is used depending on the type of text (Schäffner 1993; Dancette 1994; cited in Beeby et al, 2000) and different tools, such as dictionaries or databases (Fraser 1994: cited in Beeby et al, 2000).

On the other hand, it is also true that overexpansion of the number of subcomponents may not give a practical picture. Defending a minimalist approach, Pym (2003) underline the high degree of mismatch between what translation students are learning and what they should be asked to do. He pointed out that his more critical students considered the invariable hard core of a translation class as lists of false friends, modulation strategies, all the linguistic tricks, plus some practice on a few really specialized texts. Pym (2003) argued for a minimalist approach to translation competence “based on the production then elimination of alternatives, which he considered, can help orient translator training in times of rapid technological and professional change” while criticising the general trend among theorists of multicomponential expansions of competence that it is partly grounded in institutional interests, and leads to staying one or two steps behind market demands due to its conceptual flaw.

Taking into consideration the wide range of contexts where translation is utilized and the purposes which it serves in the academic circles, as well as the caveats involved in the efficient use of printed versus online translation sources, this research study set out to investigate the problems reported by various members of the academia concerning the conduct of translation practices and possible solutions they have generated in this regard that they may have consensus on and the attitudes toward the use of printed versus online translation tools among the academia in ELT, English philology and school of foreign languages. The responses are important given the inadequate number of the professional translators, the huge demand for translations (especially special fields), and the problems regarding structure and style, lack of the target language and culture, and terminologies of the special field.
This study did not adopt a view which geared translation to language teaching and learning, a view which was held by academicians who considered it of a secondary status, a view Munday (2001) argued against. Nevertheless, it had implications on teaching or learning English as a foreign language for the purpose of communication, which is also an important aim in translation as well. A contemporary view to translation as an autonomous interdisciplinary field may reflect positively to language teaching and learning. Köksal (2005) argued for the benefit of translation in ELT adding it to four skills (reading, listening, speaking, writing) as a fifth skill. Criticizing those who limited it to grammar translation method, Köksal (2005) argued that many ELT methods or approaches can be used in ways that include translation. According to Köksal (1996: cited in Köksal, 2005), translation contributes to error analysis as well which is important in determining teaching strategies. House (1986: 182, cited in Pym, 2003) suggested acquiring communicative competence is not only the aim of the language class but also that of the teaching of translation. Regarding the overlaps, Nord (1991: 165-166, cited in Pym, 2003) argued that translation practice is likely to develop in the language class the awareness of contrastive structures, and skills like the effective use of dictionaries. In the context of the general bilingual dictionary known as a translation dictionary, translation can be seen as a traditional exercise in second/foreign language teaching and learning (Kirkness, 2004). Contrastive analysis together with translation has also been found to have significant effect on L2 students’ lexical storage of English (Laufer and Girsai, 2008).

**METHODOLOGY**

**Participants**

A total of 73 participants with various academic positions from Atatürk University, which is located in Erzurum (AU), Namik Kemal University, which is in Tekirdağ (NKU), and Yıldız Technical University (YTU). Only at the YTU there is a translation department but it is a French department. The distribution of the participants from AU is as follows: 21 university lecturers, 7 research assistants and 10 assistant professors. On the other hand, from the School of Foreign Languages of NKU, 21 university lecturers participated in the research. The number of respondents from YTU was 14 lectureres from the school of foreign languages.

Five of the research assistants were engaged in doctoral studies and the two in MA studies at AU. Five of the AU lecturers were engaged in doctoral studies, and seven of them either had MA or on their way to graduation. The others had BA in ELT or English language and literature. There were two respondents from NKU who had MA, one was engaged in MA study, and the other had quit an MA program after courses. Most of the others had BA in English language and literature or ELT, but the two were graduates of translation studies. Emails from YTU revealed one PhD., 8 MAs, and five undergraduate degrees.

**Research Design**

The mixed method research design was used with the triangulation of the qualitative and quantitative data. A Turkish semi-structured interview was conducted in AU. The interview process helped detect specific issues. Based on the feedback, a quantitative Likert scale (1-5) questionnaire was constructed in Turkish to gain further insights. The questionnaire also included two open-ended items probing into the translation strategies of the academicians. The questionnaire was conducted in NKU and YTU the latter accessed through email distributed by the vice manager of the school of foreign languages. The rationale for using a mixed design was complementarity, which “seeks elaboration, enhancement, illustration, the clarification of the results from one method with the results from the other method” (Greene, Caracelli, and Graham, 1989; cited in Johnson and Christensen, 2004, p. 423). The qualitative data was analyzed through the content analysis, as suggested by Miles and Huberman (1994), which involves the coding for themes, looking for patterns, and making interpretations. The quantitative data was analyzed with SPSS. Data triangulation helped understanding the phenomenon from different perspectives of participants who worked in different departments. The researcher’s interpretations and conclusions were discussed with the actual participants, other members of the participant community and peers for verification and insight.

**FINDINGS**

This section aims to report the results of the qualitative and quantitative data analysis respectively. As to the qualitative data analysis, the interview results overlapped with those of the questionnaire to a considerable extent. In fact, most of the common themes that emerged in the interviews reappeared in the questionnaire for purposes of quantitizing. Apart from the common concerns raised in both types of data concerning the respondents’ attitudes towards translation and the challenges they are currently facing in their translation practices, and the frequencies of and preferences for their online and printed source use, the following themes concerning the solutions to the academicians’ translation-related problems emerged only in the interviews: the organization of translation training programs or workshops for graduate students and academicians with a particular emphasis on the improvement of translation skills and written language proficiency, which is in line...
with the suggestions of Craciunescu et al. (2004), the instruction on domain-specific terminology and the development of language awareness, discourse and sociolinguistic competence, the establishment of university-based academic writing centers and the recruitment of voluntary lecturers to work there, offering minor or (double) major programs in translation studies at undergraduate or graduate level, enhancing the quality and content of the already existing translation courses at universities by extending the range of texts covered so as to offer students an opportunity to be familiar with the domain-specific terminology, which reinforces Pym’s (1993) study revealing the shortcomings of the translation studies, and the collaboration between experienced professional translators with expertise in different fields (e.g., law or medicine) and academicians in translation classes, which is also indicated in Köksal (1995), the awareness-raising workshops at universities for the academic and non-academic circles as to the laborious, and time-consuming nature of the translation process and the steps involved to make people more conscious of the fact that translation is an academic discipline.

In addition to these themes, an increase in the share from the working capital to be allocated to the academicians involved in translation projects with industrial and commercial organizations or in the academic writing centers or the translation centers was offered as an incentive to promote the involvement of the academic staff to realize the university–industry cooperation. Regarding the participants’ self-reported use of translation strategies, the following strategies were also considered: consulting non-native speakers who are thought to be experienced translators or good at translation or native speakers for proofreading purposes, relying on one’s own intuition as an experienced EFL teacher or their own judgement in choosing the collocation or fixed expression that reflects the naturalistic, authentic use of the language. In the open-ended questionnaire items, which also formed part of the qualitative data in the study, the patterns emerged are the necessity of considering the context where the lexical items are used and the structural and discoursal constraints related to their meaning and use, the caution against the exclusive reliance on the use of one type of source (online or printed), and the need for creativity and imagination in the translation to enhance the quality of the translation practice.

With respect to the results of the quantitative data (the Likert-scale items), the results indicated a great deal of parallelism to ideas expressed in the interviews as mentioned above. As for the reliability of the likert scale questions, the cronbach a reliability scale is .86 (high reliability) for AU, .772 (moderate reliability) for NKU, and .81 (high reliability) for YTU. Considering translation as an important aim in teaching English is very common among AU respondents with the mean of 3.974 compared to NKU and YTU respondents (the means of 3.4762 and 3.3571 respectively – little below 3.5) who seem to be undecided. This is understandable given their priorities. However, as for whether they think translation activities contribute, the mean scores of both AU, NKU, and YTU are much above 3.5 (4.1579, 3.9524, and 4.00 respectively) – for convenience, the first means belong to AU, the second to NKU, and the third to YTU). AU and NKU respondents think that the time and energy they need to devote to their own work, in other words, the work they are employed for, is consumed by the demands of the academicians of the departments other than their own (Qa3: 4.3947 and 4.2381), but the demand at YTU are lower (3.1429). Nevertheless, as regards the attitudes of colleagues from other departments, the picture reflects lack of awareness of the fact that translation is demanding and time consuming (Qa4: 4.2895, 4.3333, and 4.0714).

The recruitment of professional translators are believed to reverberate in the translation activities of their universities considerably (Qa5: 4.5263, 4.7619, and 4.2143). They believe that the ones experienced in both academic settings and professional market of translation should be preferred (Qa6: 4.3158, 4.4286, and 4.2857). The diversity of experience should cover academic writings, commerce, industry, etc. Working interactively with these translators would contribute positively to the improvement of the quality of their translations (Qa7: 4.1316, 4.3333, and 4.1429). It is useful to establish a translation center where these translators work together with volunteering academicians (Qa8: 4.2632, 4.3333, and 4.0714). It is possible to carry out translation activities in a systematic organisation in a manner which contributes to the economy (Qa9: 4.1316, 4.3810, and 3.9229). There is not as much agreements among YTU respondents as among AU and NKU respondents to accept the idea of such a translation center run and supervised by professional translators (AU: 4.1053, NKU: 4.5238, and YTU: 3.2143)

The academicians who want to work in this center should be paid in proportion to their contribution (Qa11: 4.2895, 4.4286, and 4.50). The share they get form the working capital should be increased (Qa12: 4.00, 4.3333, and 4.0714). If talented students also work in the center, their practice would help improve their translation quality, and decrease the workload of the center (Qa13: 3.8684, 4.2381, and 4.4286). Their participation can be certified additionally along with their graduation documents (Qa14: 3.5526, 3.8571, and 4.2857 – the mean of YTU is much higher at this liberal item). The quality of the translations improves with the recruited professional translators checking the texts (Qa15: 3.8158, 4.1429, and 4.3571). This center can function as an academic writing center contributing to the acceptance of the number of articles to be submitted by the academic staff.
Terminology problems along with their solutions can be recorded and used to construct a database (Qa20: 4.2632, 4.7143, and 4.3571). Producing solutions to the problems related to collocations is important for the naturalistic use of the language (Qa21: 4.1053, 4.5238, and 4.00). It is useful if the content of the database is classified into subfields (Qa22: 4.2368, 4.6190, and 4.2857). It is also useful if frequently occurring translation problems and their solutions are accessed online (Qa23: 4.2105, 4.6667, and 4.6429). As for questions b1 and b2, most of the respondents in AU and NKU have the tendency to use online tools rather than the printed with 68% and 71.4% respectively selecting the fourth item (I tend to use online sources more often.). There is similar attitude in half of the YTU respondents selecting the fourth item, and almost one third always using online sources. This echoes Sanchez’ (2006) views of online tools as promising solutions to the translation problems. In AU and NKU, the percentage of respondents agreeing that there should be a tendency to use more online sources is highest: 68.4 and 57% respectively. YTU respondents present similarity with 42.9% in addition to 14.3% for the related 4th and 5th items.

Table 1. Responses of AU and NKU for questionnaire items b1 and b2

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>Number (percent.) AU for B1</td>
<td>1 (2.6%)</td>
<td>7 (18.4%)</td>
<td>2 (5.3%)</td>
<td>26 (68.4%)</td>
<td>2 (5.3%)</td>
</tr>
<tr>
<td>Number (percent.) NKU for B1</td>
<td>-</td>
<td>4 (19%)</td>
<td>-</td>
<td>15 (71.4%)</td>
<td>2 (9.5%)</td>
</tr>
<tr>
<td>Number (percent.) YTU for B1</td>
<td>-</td>
<td>2 (14.3%)</td>
<td>1 (7.1%)</td>
<td>7 (50%)</td>
<td>4 (28.6%)</td>
</tr>
<tr>
<td>Number (percent.) AU for B2</td>
<td>-</td>
<td>5 (13.2%)</td>
<td>7 (18.4%)</td>
<td>26 (68.4%)</td>
<td>-</td>
</tr>
<tr>
<td>Number (percent.) NKU for B2</td>
<td>-</td>
<td>2 (9.5%)</td>
<td>7 (33.3%)</td>
<td>12 (57.1%)</td>
<td>-</td>
</tr>
<tr>
<td>Number (percent.) YTU for B2</td>
<td>-</td>
<td>2 (14.3%)</td>
<td>4 (28.6%)</td>
<td>6 (42.9%)</td>
<td>2 (14.3%)</td>
</tr>
</tbody>
</table>

The mean scores do not indicate are below 3.5 on whether they use bilingual or monolingual dictionaries, or whether they translate from English to Turkish, or from Turkish to English. (Qb3: 2.9737, 2.7143, and 2.9286; b5: 2.9211, 3.1905, and 3.2857; b6: 3.1842, 2.9048, and 2.7857; b7: 3.1053, 2.6190, and 2.9286). The mean scores for the questions to do with printed dictionaries are low among which the highest of the low scores belong to the monolingual printed dictionary use (Qb4 3.4737, 3.1905, 3.2857). The least difference between online and printed dictionaries is in the category of monolingual dictionaries.

Participants reported using online dictionaries frequently (Qb8: 3.9474, 4.1905, and 4.00). NKU respondents’ mean is little below 3.5 as regards monolingual online dictionaries compared to others, which are high (Qb9: 3.6379, 3.4286, and 3.8571). There is such a difference among the universities in popularity of bilingual online dictionaries (Qb10: 3.6579, 3.8571, and 3.8571). There is no big difference in the direction of the translation.

When asked about their frequency of using search engines in translation their response was positive (Qb13: 3.5789, 3.6190, and 4.2857). The AU, NKU, and YTU respondents responded more positively to using search engine alternately with a dictionary if it is an online one (3.5789, 3.9048, and 4.00). The means are lower when asked about using printed (2.8421, 2.2381, and 3.1429).

In AU, NKU, and YTU, the participants’ mean score is low as regards their experience of having worked with the expert of a field (on which translation is done). The reason they report as being terminological differences (Qb18) is 4.0952 in NKU whereas it is lower in AU (3.3947) and YTU (3.1429), the difference possibly due to more experience. Participants have not been able to find opportunity to co-work with experts of a field who have terminological familiarity (Qb19: 2.4737, 1.8095, and 2.2857). Many AU and NKU respondents report that they have not used database (Qb20: 3.0263, 2.9524), as frequently as YTU respondents (3.7143).

All the questions related to use of machine translation have low means (even much below 2 for some questions) in the three universities, which is quite in line with the comments of Sanchez (2006) and Craciunescu et al. (2004) concerning the inefficiency of machine translation. There is a similar picture regarding whether they trust machine translation. It did not matter whether English is source or target language in both the frequency of use and the trust issue.

The participants all believed that it is important that the translation should be close to natural English as regards style and structure (Qb26: 3.8684, 4.0476, and 4.00), and full check for this kind of accuracy of style and structure should be necessary when a nonnative speaker of English translates from Turkish to English (Qb28:
They all want to be informed about the technological means which would save time for the closeness of the translation to natural English use regarding style and structure (Q30: 4.0789, 4.5238, 4.1429), which indicates that the participants match the ideal translator profile described by Korkas, Pavlides, and Rogers (2005), Pym (2003), (Craciunescu et al, 2004), and Biau, Gil and Pym (2006, cited in Sanchez, 2006). The respondents also underline the need for the high number and quality of databases. The number of databases should be increased, which is important whether they translate from English to Turkish (Qb31: 4.00, 4.1905, 4.2143), or from Turkish to English (Qb32: 4.2105, 4.3333, and 4.2857).

According to AU and NKU respondents, using both the dictionary and search engine is likely to solve the problems of accuracy of style and structure in translations (Qc3: 2.5526 and 2.8095), in contrast to many more YTU respondents who believed that it is much more likely (4.1429). The difference between the former and YTU respondents is that the latter assumed that their knowledge on using search engines for this aim was adequate to solve many problems practically (Qc4: 2.7895, 2.8571, and 4.00). As regards the comparison of the frequency with which they use dictionary and search engine, the total percentages of respondents selecting 3 and 4 suggest that in their actual practice they tend to be closer and more oriented to the search engine end of the continuum: the alternate use of both dictionary and search engine. In fact they believed that they should do so more than they actually do. These suggest that they think their practice should be more oriented towards using search engines more frequently in their alternate use with dictionaries.

### Table 2. Responses of AU and NKU for questionnaire items C3 and C4

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Number (percent.) AU for C3</td>
<td>7 (18.4 %)</td>
<td>13 (34.2 %)</td>
<td>8 (21.1 %)</td>
<td>10 (26.3 %)</td>
<td>-</td>
</tr>
<tr>
<td>Number (percent.) NKU for C3</td>
<td>1 (4.8 %)</td>
<td>9 (42.9 %)</td>
<td>4 (19 %)</td>
<td>7 (33.3 %)</td>
<td>-</td>
</tr>
<tr>
<td>Number (percent.) YTU for C3</td>
<td>-</td>
<td>-</td>
<td>1 (7.1 %)</td>
<td>10 (71.4 %)</td>
<td>3 (21.4 %)</td>
</tr>
<tr>
<td>Number (percent.) AU for C4</td>
<td>3 (7.9 %)</td>
<td>13 (34.2 %)</td>
<td>11 (28.9 %)</td>
<td>11 (28.9 %)</td>
<td>-</td>
</tr>
<tr>
<td>Number (percent.) NKU for C4</td>
<td>-</td>
<td>8 (38.1 %)</td>
<td>8 (38.1 %)</td>
<td>5 (23.8 %)</td>
<td>-</td>
</tr>
<tr>
<td>Number (percent.) YTU for C4</td>
<td>-</td>
<td>-</td>
<td>5 (35.7 %)</td>
<td>4 (28.6 %)</td>
<td>5 (35.7 %)</td>
</tr>
</tbody>
</table>

### DISCUSSION AND CONCLUSION

The findings revealed that the academicians working in English language and literature, ELT, or school of foreign languages had positive attitudes toward improving their applications of online tools. Most of them used search engine and online dictionaries in turns. The search engine indexes large corpora. The corpora include parallel texts we can benefit from to make our translation sound naturalistic. According to Stubbs (2004), corpora provide the association patterns relating item and context (lexico-grammatical units, and style and register). In terms of accuracy, AU and NKU respondents indicated the need to make the most of alternate use of dictionaries and search engines. It was more common among the YTU respondents to believe that they can use these both to solve problems of style and structure. We need both accuracy and fluency while translating. In terms of fluency, respondents from all the three universities underline the need to work fast with their open attitude to be informed of timesaving technological know-how. Therefore, it is possible to argue that the demand for translation workshops or in-service trainings may be high and they can raise the level of sophistication and efficiency they used the technological means. The respondents in this study believed that they can develop their online skills with professional translators’ know-how.

A similar study has been found in relevant literature that hypothesizes that a course specially geared towards translating as a communicative activity will diminish differences between translations of university language students and those of professional translators (e.g., Dimitrova’s project, 1996-1997). Secondly, setting up multilingual parallel texts is perceived in Europe as a good investment not in the short term but in the midterm or long term for teaching translation and doing contrastive linguistic analysis, which can also reflect on teaching languages (Bernardini, 2003). The level of awareness should be raised on this issue as the responses to a related question did not indicate very high.

The results can contribute to translation projects if they are shared with the university presidents. The universities can recruit professional translators who can run translation centers where they can guide, work
interactively with and supervise the volunteering academicians and maybe students. They can also coordinate collaborations with the experts of the fields of translations. Databases can be constructed. According to Kirkness (2004), professional translators can be expert informants for practicing lexicographers.

With all the contributions, academicians in universities can develop the command of academic English, and increase the quality and number of their articles published internationally. The project can have lasting effect on academicians’ promotion as well as advances in international collaborations between the institutions outside the academia including cultural, commercial and industrial organisations. Stating that if institutions do not match the rapid change of our world, they do not survive, Hayakawa and Hayakawa (1990) emphasize the importance of the technology. An interesting example from Turkey is worth to mention. An accredited translation company in Turkey, DIYE held its third translation technologies workshop in collaboration with Doğuş University with participation of students of five universities and professors from Marmara, Yıldız Technical and Beykent universities and Mr. Sabri Gürses, founder of the online translation studies magazine “Çeviribilim”. They all gave positive feedback on the up-to-date information provided “on the language technologies field as well as fundamental knowledge on project management, translation memories and terminology use with translation memories” (DIYE, n.d.). However, the duration of this workshop was not very long, but it was the courtesy of the private company after all which gave this service for free.

Turning back to our study, although it was conducted in three different university contexts in Turkey, the findings obtained from both universities revealed several similarities, which may imply the challenges, problematic issues, and suggestions for solutions that are likely to reflect those experienced yet articulated by academicians in many other settings in Turkey. Solutions can be found to the benefit of all stakeholders. In fact, a recent speech of Prof. Dr. Yusuf Özcan, the head of the Higher Education Council, delivered at Atatürk University in the first semester of the 2009 and 2010 academic year can be regarded as reinforcing some of the findings. He argued that relations between university and society should be stronger. He pointed out the negative impact on the development of society of the lack of cooperation between the industry and the university. The recruitment of professional translators who are experts in their fields can contribute to the enhancement of translation competencies of academicians and/or students. Academicians or students having benefited from their work can perform better at their translation classes. Student involvement can be encouraged through extracurricular translation projects at the end of which their work can be accredited on their graduation documents.

There is also an issue of unsatisfactory share from working capital, Prof. Dr. İsmail Yüksek (the Rector of Yıldız University, İstanbul) stated that an increase in the allocation of shares in the working capital was considered in related commissions (universitemedya.tv, 27 February 2010). Prof Dr. Özcan’s speech in his visit to Namık Kemal University corroborated this when he mentioned about raising the percentage of working capital can result in even 85 % to the favor of those who served in institutions running with working capital. If this is realized, it may encourage the realization of a university-based translation centers, and support the academicians’ suggestions as to the provision of a financial incentive to increase the involvement of academicians in the joint translation-related projects with the industrial organizations. Without such incentive, the projects may probably fail. An associate professor at the department of translation at Yıldız Technical University, Karadağ (A. B. Karadağ, personal communication, 29 June 2010) informed that a translation center founded in Istanbul University hired services of assistants of the translation department. There was a huge demand from many departments of the university, and the assistants started to work extra hours. Before long, the assistants resigned and the system fell apart. Asked whether a translation unit may serve to the benefit of the university academic personnel, several academicians interviewed informally at Namık Kemal University stated that lecturers with improved translation skills can help those academicians who are – should be – active in the process of writing their articles if they counsel them occasionally for the problems of style and terminology.

The fact that our sample of respondents was not large limited the possibility of generalization. YTU respondents were reached by email sent to them by their administrator. 14 respondents replied, how well this low participation represented the YTU context is a question. Another limitation of the small size was that attitudinal differences or differences of frequency in using tools in terms of professional, age and educational level groups could not be compared. According to Lexis Nexis technology gap survey, American white-collar workers all agreed that technology made it easier to get up-to-the-minute information (95 percent agree), perform research (94 percent agree), improve productivity (90 percent) and manage information (87 percent). However, as to whether they actually applied technology, in other words, when asked specifically on the frequency of their use of technology, the picture differed depending on their age. The most junior workers (aged under 28) had highest averages; the most senior workers (aged 44 to 60) had the low averages, whereas those aged 29 to 43 applied technologies in moderation. Although the report had respondents working in education sector, whether a similar
pattern may emerge in universities regarding the use of technological tools in translation tends to be much less probable assuming the universities are competitive.

In future, studies can be conducted with larger population of respondents. It is also important to consider that the study cannot be generalized to several age groups since mainly their ages range from between mid twenties to mid thirties. Further longitudinal studies into the translation-related problems, the current translation practices and the suggestions for the improvement of existing practices in other Turkish contexts may prove to be beneficial for the improvement of the quality of the existing translation practices and translated works, and contribute to the academic excellence of Turkish universities.

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KorkasPavlidesRogersPaper.pdf


QUESTIONNAIRE

a) I strongly disagree    b) I disagree    c) I am not sure  d) I agree  e) I strongly agree

PART A. Translation activities

1. Translation is one of the important targets in English Language Teaching (ELT).
   AU: 3.9474 (.95712)   NKU: 3.4762 (1.03049)   YTU: 3.3571 (1.33631)

2. Translation activities have a beneficial impact on learning English.
   AU: 4.1579 (.59395)   NKU: 3.9524 (.86465)   YTU: 4.00 (.39223)

3. The translation demands that are made by academicians other than the ELT departments take my time and energy that I prefer to devote to my career.
   AU: 4.3947 (.82329)   NKU: 4.2381 (.99523)   YTU: 3.1429 (.86444)

4. The translation demands tend to reflect the attitude that indicates a lack of awareness towards the time-consuming and painstaking nature of translation.
   AU: 4.2895 (.89768)   NKU: 4.3333 (.79582)   YTU: 4.0714 (.82874)

5. The recruitment of experienced professional translators at university generally makes a substantial contribution to the translation activities.
   AU: 4.5263 (.68721)   NKU: 4.7619 (.43644)   YTU: 4.2143 (.89258)

6. A translator’s academic experience as well as professional experience in the translation market is a reason for choice.
   AU: 4.3158 (.61973)   NKU: 4.4286 (.67612)   YTU: 4.2857 (.46881)

7. Working with the translators recruited by the university interactively is likely to make a valuable contribution to the improvement of academicians’ translations.
   AU: 4.1316 (.70408)   NKU: 4.3333 (.65828)   YTU: 4.1429 (.86444)

8. It is a good idea to establish a translation center where experienced translators and volunteer academicians are able to work together.
   AU: 4.2632 (.97770)   NKU: 4.3333 (.65828)   YTU: 4.0714 (.99725)

9. It is possible to conduct translation activities in a center within the framework of a systematic organization in such a way to contribute to economy.
   AU: 4.1316 (.57756)   NKU: 4.3810 (.58959)   YTU: 3.9229 (.72976)

10. It would be more useful if the work in a translation center is to be run and supervised by professional translators experienced in translations which are related to the academia and other fields (e.g., commerce and industry).
    AU: 4.1053 (.83146)   NKU: 4.5238 (.51177)   YTU: 3.2143 (.89258)

11. It would be nice to get paid in proportion to their contribution to the translation process for those academic personnel who wish to work in the translation center.
    AU: 4.2895 (.65380)   NKU: 4.4286 (.59761)   YTU: 4.50 (.51887)

12. It would be a good idea to increase the shares of those doing translation in the working capital.
    AU: 4.00 (.92998)   NKU: 4.3333 (.57735)   YTU: 4.0714 (.47463)

13. If talented students too are to work in the translation center, these students may be able to improve their translation skills and contribute to the translation activities.
    AU: 3.8684 (1.01798)   NKU: 4.2381 (.88909)   YTU: 4.4286 (.51355)

14. The contributions of the students in the translation center to the translation projects can be credited in their graduation documents under a separate title.
    AU: 3.5526 (1.17858)   NKU: 3.8571 (1.06234)   YTU: 4.2857 (.46881)

15. The supervision of the students’ work by professional translators in turns would improve the quality of the translations.
    AU: 3.8158 (.89610)   NKU: 4.1429 (1.01419)   YTU: 4.3571 (.49725)

16. The translation center where experienced translators are employed can function as an academic writing center, thereby contributing to an increase in the number of articles accepted to the academic journals.
    AU: 4.0263 (.75290)   NKU: 4.5238 (.60159)   YTU: 4.00 (.87706)

17. The translation center can also contribute to the translation activities of the academic personnel in other universities.
    AU: 3.7368 (1.10733)   NKU: 3.9048 (1.09109)   YTU: 3.7857 (.80178)

18. The translation centers can contribute to the industrial and commercial institutions in the city.
    AU: 3.7632 (.81983)   NKU: 4.0952 (.88909)   YTU: 3.5386 (.84265)

19. It is necessary for the translation center to give priority to meeting the demands from the local academic personnel.
    AU: 4.00 (.81983)   NKU: 4.0952 (.88909)   YTU: 4.1429 (.53452)

20. It would be good for such a translation center to form a database by which they demonstrate terminological problems along with their solutions.
    AU: 4.2632 (.60109)   NKU: 4.7143 (.46291)   YTU: 4.3571 (.49725)
21. It is important for the naturalistic use of language if the translation center solves problems of collocations (for instance, using the phrase ‘see a dream’ although it is necessary to prefer the phrase ‘have a dream’.)

AU: 4.1053 (.83146)  NKU: 4.5238 (.67964)  YTU: 4.00 (.87706)

22. It would be good to classify the content in the database according to fields.

AU: 4.2368 (.63392)  NKU: 4.6190 (.49761)  YTU: 4.2857 (.61125)

23. It would be good to have online access to the commonly-faced translation problems and their solutions.

AU: 4.2105 (.70358)  NKU: 4.6667 (.48305)  YTU: 4.6429 (.49725)

PART B.
Printed versus online source use in translation
Directions: Circle the choice that best applies to you. (You need to circle only one choice.)

1. If you compare your use of printed and online sources in doing translation:
   1. I always use printed source
   2. I have a tendency to use printed sources more.
   3. I do not tend to prefer printed sources to online sources or vice versa.
   4. I tend to use online sources more often.
   5. I always use online sources.

AU: 4.1053 (.83146)  NKU: 4.5238 (.67964)  YTU: 4.00 (.87706)

2. In order to do translation most effectively:
   1. Printed sources must always be used
   2. There should be a tendency to use more printed sources.
   3. There should not be a tendency to use more printed or online sources.
   4. There should be a tendency to use more online sources.
   5. Online sources must always be used.

   a) never  b) rarely  c) sometimes  d) often  e) always

Printed dictionary use
3. I -------------- use printed dictionaries while doing translation.
   AU: 2.9737 (.85383)  NKU: 2.7143 (.84515)  YTU: 2.9286 (1.07161)

4. I -------------- use monolingual printed dictionaries (e.g., English-English) while doing translation?
   AU: 3.4737 (.97916)  NKU: 3.1905 (1.03049)  YTU: 3.0714 (1.14114)

5. I -------------- use bilingual dictionaries (e.g., English-Turkish or Turkish-English)?
   AU: 2.9211 (.81809)  NKU: 3.1905 (1.07792)  YTU: 3.2857 (1.32599)

6. I -------------- do translation from English to Turkish using printed bilingual dictionaries?
   AU: 3.1842 (.83359)  NKU: 2.9048 (1.4426)  YTU: 2.7857 (.89258)

7. I -------------- do translation from Turkish to English using printed bilingual dictionaries?
   AU: 3.1053 (.86335)  NKU: 2.6190 (1.02353)  YTU: 2.9286 (.91687)

Online dictionary use
8. I -------------- use online dictionaries while doing translation.
   AU: 3.9474 (.83.658)  NKU: 4.1905 (.60159)  YTU: 4.29286 (1.07161)

9. I -------------- use online monolingual dictionaries (e.g., English-English) while doing translation?
   AU: 3.6379 (.99786)  NKU: 3.4286 (.74642)  YTU: 3.8571 (1.66299)

10. I ------------ use bilingual online dictionaries (e.g., English-Turkish or Turkish-English) while doing translation.
   AU: 3.6579 (.87846)  NKU: 3.8571 (.79828)  YTU: 3.8571 (.77033)

11. I -------------- use bilingual online dictionaries while doing translation from English to Turkish.
    AU: 3.4474 (.89132)  NKU: 3.2857 (.64365)  YTU: 3.7143 (.82542)

12. I -------------- use online bilingual dictionaries while doing translation from Turkish to English.
    AU: 3.3158 (.93304)  NKU: 3.1905 (.67964)  YTU: 3.7857 (.80178)

Use of the search engine
13. I -------------- use the search engine while doing translation.
    AU: 3.5789 (.97625)  NKU: 3.6190 (.97346)  YTU: 4.2857 (.61125)

14. I -------------- use both the search engine and dictionary in turns while doing translation.
    AU: 3.2895 (.86705)  NKU: 3.2381 (.89523)  YTU: 4.2143 (.80178)

15. The dictionary which I use with the search engine in turns is -------------- a printed one.
    AU: 2.8421 (.94515)  NKU: 2.2381 (.94365)  YTU: 3.1429 (.94926)

16. The dictionary which I use with the search engine in turns is -------------- an online one.
    AU: 3.5789 (.97625)  NKU: 3.9048 (.76842)  YTU: 4.00 (.55470)
Working with an expert, and special field
17. In translations outside the scope of my specialization, I have  worked with the expert of the special field.

18. The reason of the frequency I am referring to in the response to the 17th question is  the prospect of having terminology problems.

19. I have had opportunities to work with an expert who is familiar with the terms and the English equivalents of the special field beyond the scope of my area of specialization.

20. I use terminology databases while doing translation.

Machine translation
21. I make use of machine translation while doing translation from Turkish to English (translations done via online or offline translation programs).

22. I make use of machine translation while doing translation from English to Turkish (translations done via online or offline translation programs).

23. Machine translation is reliable in translations from Turkish to English (translations done via online or offline translation programs).

24. Machine translation is reliable in translations from English to Turkish (translations done via online or offline translation programs).

Parallel Texts
25. Using sources where the translated equivalents of the texts (bilingual parallel texts) in translations are presented next to one another (together) is an effective method.

26. It is important to make use of parallel texts in English to check whether the translation is a close approximation of natural English in terms of style and structure.

27. I refer to parallel texts in English to check whether my translation is a close approximation of natural English in terms of style and structure.

28. It is necessary for a non-native speaker to check the accuracy of the language he/she has used in his/her translations from Turkish to English in terms of style and structure to the maximum.

29. I cannot look at parallel texts as often as I would like to as my time is limited.

30. If there are timesaving technological possibilities to enable my translation to approximate to natural English in terms of style and structure. I would like to be informed of how to use them.

31. It is necessary to increase the number of databases for translations from Turkish to English.

32. It is necessary to increase the quality of databases for translations from Turkish to English.

PART C
Parallel expressions and formulaic expressions
1. (open ended question) Suppose that you would like to describe a person who smokes a lot and you are in a dilemma between ‘heavy smoker’ and ‘much smoker’. Please briefly explain below the strategy that you employ to use expressions as natural as native speakers use:

2. (open ended question) For example, if we accept that you would like to determine the more-frequently-used one (i.e., ‘expansive access’ or ‘widespread access’), could you briefly explain below the practical strategies you employ to solve this problem:
3. Using both the dictionary and the search engine to ensure the accuracy of the translations in terms of style and structure is likely to solve the problem.

a) I strongly disagree  b) I disagree  c) I am not sure  d) I agree  e) I strongly agree

AU: 2.5526 (1.08297)  NKU: 2.8095 ( .96304)  YTU: 4.1429 ( .53452)

4. I have a high level of technical knowledge related to how to use the search engine to ensure the accuracy of the translations in terms of style and structure.

a) I strongly disagree  b) I disagree  c) I am not sure  d) I agree  e) I strongly agree

AU: 2.7895 ( .98077)  NKU: 2.8571 ( .79282)  YTU: 4.00 (.87706)

If you are using the dictionary or the search engine, please choose one of the following alternatives (ONLY ONE) that best describes your situation)

C5:

1. I only use the dictionary.
2. I use the search engine (except for looking for a dictionary in the search engine) and the dictionary in turns (I use the dictionary more often than the search engine)
3. I use both the dictionary and the search engine (except for looking for a dictionary in the search engine) in turns, but I do not have a tendency to use one more than the other.
4. I use the search engine (except for looking for a dictionary in it) more but I use the dictionary and the search engine in turns.
5. I only use the search engine (except for looking for a dictionary in it)

C6:

1. Only the dictionary should be used.
2. The search engine should be used in turns with the dictionary (but the dictionary should be preferred more often).
3. Both the dictionary and the search engine should be used in turns but there should not be a tendency to use one more than the other.
4. Both the dictionary and the search engine should be used in turns but the search engine should be used more often.
5. Only the search engine should be used.

xx-This article is the extended version of the paper which was presented at IETC (International Educational Technology Conference) 2010 and published in IETC 2010 Proceedings Book.
USE OF NEWS ARTICLES AND ANNOUNCEMENTS ON OFFICIAL WEBSITES OF UNIVERSITIES

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ABSTRACT
Since corporate websites have become indispensable tools of public relations in parallel with the increase in the number of Internet users, they offer remarkable opportunities for universities as well. University websites are operated in a more professional manner due to increasing number of visits by not only students and the academic staff, but also by various target groups such as families of students, potential students, persons and institutions who would like to take advantage of services offered, and media and public institutions. Official websites have a potential to create a better communication between universities and societies that they are part, as well as bringing academic knowledge to the public agenda more often. In this research, most-visited official websites of universities in Turkey are compared with most-visited official websites of universities in the world in order to better utilize this potential. A content analysis has been done in order to determine differences between most-visited official websites of universities in Turkey and in the world in terms of current news and announcements.

Key words: Internet, News paper, Web Sites

1. INTRODUCTION
We are witnessing the rise of the ‘new’ media associated with digital technologies, convergence and networking. (Flew , 2007) Today, no one would dispute that the internet has been an important part of our communicative infrastructure for some years. (Brügger, 2009) The internet is a medium of information and communication, first of all. (Van Dijk, 2005) The Internet medium and particularly the World Wide Web were designed for the free exchange of information and to maximize ease of access to information. (Lemke, 1999) The web is made up of billions of individual webpages, typically organized into more or less coherent collections called websites. (Park, Thelwall, 2006) One of the most significant developments for media in recent decades has been the emergence of the internet and the World Wide Web. (Gorman, McLean, 2003) Institutions create their own websites along with media organization.

Institutions have gained a new media organ with corporate websites. Institutions are able to explain in detail to their target audience who they are, what services they offer, who they can communicate with and how, if they would like to utilize their services. People who would like to follow the institution and its activities could reach up-to-date information through their corporate websites in a fast and economical manner. Corporations are able to convey their messages with no limitations of space, time and in an economical way. Another important characteristic of websites is that they help build a direct communication between the institution and its target audience.

Gerhards and Schäfer note that the structure of internet communication is fundamentally different from the old media and senders may find it easier to present themselves and their issues online. (Gerhards and Schäfer, 2010) Internet has the potential of breake up the monopoly of the culture industry. (Holmes, 2005) Internet sometimes calls “alternative media” too. But internet should produce alternative content to be alternative media. (Atabek, 2005)

Corporate websites are becoming more and more important for institutions that would like to better communicate with their target audiences. Corporate websites enable various departments within institutions, such as production, distribution, human resources or marketing, carry out their tasks in a more economical manner; furthermore, corporate websites have become an indispensable staple of public relations practices. Although corporate websites could carry different characteristics in accordance with the purpose of the institution and the sector it is in, most of them carry common purposes. These are listed by Haig as: (Saymer, 2008)

-Attracting new visitors
-Communicating with existing visitors
-Ensuring repeat visits
-Drawing visitors’ attention
-Creating a positive image of the corporation in visitors’ minds

Messages containing desired content and style could be broadcast on the corporate websites whenever wished. Corporations are able to see messages sent by their visitors through their websites, as well as quickly gathering...
Corporate websites are developing and changing daily as a result of the development of Internet network, the decrease in the cost of technology, and the increase of Internet users. Potentials of the Internet are better understood with new Internet applications entering our lives every day. “However, sole technology usage does not contribute to building of a beneficial communication between institutions and their target audiences. Reciprocal communication concept and how technology is being used is more important” (Park and Reber) (Güdemir, 2010). One of the most important problems presented to companies who would like to use their websites in a more effective manner and to compete with their rivals on the Internet is the preparation of content being published on the website.

Scott tells that site owners become so concerned about technology and design but they totally forget that great content is the most important aspect of any web site. Scott note that the best web sites focus primarily on content. (Scott, 2009) The web sites should be prepared by considering a wide range of audiences such as researchers, teachers, students and others who want to be informed. (Kutluca, Aydn, Baki, 2009) A systematic study that is done in a professional way is needed in order to research the information that is going to be conveyed to the target audience, verifying its accuracy, finalizing the text in an easier way for the target audience to understand, preparing it to be launched on the website when desired, its publishing, updating of this information when needed and for removing it. Efforts made with regards to publishing policy of the official website that is prepared in accordance with the purposes of the institution as well as needs and desires of the institution’s target population should continue with regards to visitor numbers and new Internet applications.

Corporate websites have become important tools for various institutions, as well as universities. These websites, that are visited by thousands of students, by the academic staff, as well as by people who would like to take advantage of services being offered, are being managed in a more professional manner every day. Universities carry big importance for the society because of the education they offer and scientific research they conduct; as a result of this, universities are at the top of the list of the institutions that can utilize the Internet in the most productive way possible in terms of creating knowledge and sharing of it. When compared with examples from abroad, it is seen that universities in our country do not use make use of these resources presented by the Internet. Official websites have the potential to create a stronger communication between universities and the societies they are in and to bring scientific knowledge to masses. In order to take advantage of this potential, most-visited official university websites in Turkey have been compared in our research with the most-visited official university websites in the world. Differences between most-visited official university websites in Turkey and abroad were compared to find out differences in their usage of current news and announcements.

2. PURPOSE AND METHOD
In this research, 10 most-visited official university websites in Turkey and abroad have been analyzed. In order to confirm data, Content Analysis method described by Berelson (1952) as “depiction of communication from an objective, systematic and quantitative way” have been used in the research. (Bilgin, 2000)

Located in Spain, the Cybermetrics Lab that is a part of the Centro de Ciencias Humanas y Sociales (CCHS), that is contained within National Research Council the Consejo Superior de Investigaciones Científicas (CSIC), ranks the official most-visited university websites in the world. According to the “Webometrics Ranking of World Universities” prepared by the Cybermetrics Lab., these are the 10 most-visited university websites: Massachusetts Institute of Technology, Harvard University, Stanford University, University of California Berkeley, Cornell University, University of Wisconsin Madison, University of Michigan, University of Minnesota, University of Washington, University of Pennsylvania. (http://www.webometrics.info/top12000.asp, 2011) According to the same research these are the 10 most-visited university websites in Turkey: Middle East Technical University, Bilkent University, Bogazici University, Istanbul Technical University, Hacettepe University, Ankara University, University of Anatolia, Sabanci University, Gazi University, Dokuz Eylul University. (http://www.webometrics.info/rank_by_country.asp?country=tr, 2011)

In order to do the research, a snapshot was taken on March 12, 2011 from the Main Page of official websites of universities. Sections of corporate websites in order to determine which questions are answered have been examined. It is, of course, possible to answer more than one answer in one section in a web site. In this research, however, we have taken into consideration the main question answered in the relevant section. Later, these questions were placed into 4 main categories based on their characteristics. These categories are determined as, information about the university, ways of contacting and communicating with the university,
Easier and faster ways of reaching information about the university and services offered, admissions into the university / events, invitations and conditions for using services and resources offered. Questions within each category used in our research are listed below;

### A- Information about the University

<table>
<thead>
<tr>
<th>QUESTIONS ANSWERED</th>
<th>SECTIONS OF THE WEBSITES THAT ANSWER THE QUESTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Who we are?</td>
<td>Name, logo, history of the university</td>
</tr>
<tr>
<td>2 What we produce as a result of works we conduct?</td>
<td>Publications done by researchers, research findings, awards, success stories of graduates...</td>
</tr>
<tr>
<td>3 What do we do? What services we give?</td>
<td>Programs offered, researches being conducted, services offered to the public, works in Public Relations and Social Responsibility</td>
</tr>
<tr>
<td>4 The infrastructure, life on campus, support services?</td>
<td>Campuses, administrative units and offices, facilities on campuses, laboratories, museums, galleries, collections, botanical gardens, libraries, bookstores, shopping facilities, food services, housing opportunities, security, health services/hospital, day care, -Artistic and athletic activities on campus, student events -Support Services: counselling services, career services, facilities for the disabled...</td>
</tr>
<tr>
<td>5 Who works at the university? What are their work principles?</td>
<td>Administration, administrative policy, Vision/mission and working principles, personnel policies, job opportunities, retirees...</td>
</tr>
</tbody>
</table>

### B- Ways of reaching and contacting the University

<table>
<thead>
<tr>
<th>QUESTIONS ANSWERED</th>
<th>SECTIONS OF THE WEBSITES THAT ANSWER THE QUESTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 What are ways of reaching and contacting the university?</td>
<td>Contact Information (telephone, address, fax, email address), directory, map, getting to the university using public transportation, directions...</td>
</tr>
</tbody>
</table>

### C- Easier and faster access to information relating to the university and to services offered

<table>
<thead>
<tr>
<th>QUESTIONS ANSWERED</th>
<th>SECTIONS OF THE WEBSITES THAT ANSWER THE QUESTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 Media organs to reach information pertaining to the university</td>
<td>Magazines, Newspapers, Mail, Blog, Podcast, Social Media, Website...</td>
</tr>
<tr>
<td>8 What are practices that provide access to services and information from the University?</td>
<td>Being informed about services and events at the university through university’s own e-mail system, SMS and website, to be able to reach desired information and to send information to the related persons, a search engine built into the website, special pages prepared for its target audience (Graduates, business world and entrepreneurs, potential students, academic staff and employees, media, students other than university students, parents and friends, visitors, Media, donators, job seekers, neighbours) Online directory, Online library catalogue...</td>
</tr>
</tbody>
</table>

### D- Admissions to the University. Announcements and conditions to join events, services and resources

<table>
<thead>
<tr>
<th>QUESTIONS ANSWERED</th>
<th>SECTIONS OF THE WEBSITES THAT ANSWER THE QUESTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 How are admissions conducted?</td>
<td>Special pages what contain information needed by future students, admissions conditions, Fees and Scholarships, Information for those who might wish to visit the campus, Information for those who might wish to donate to the university, how to rent university facilities, campus tours...</td>
</tr>
</tbody>
</table>
Secondly, current news and announcements that were on the official websites of universities on March 12, 2011 were analysed according to: their amounts, whether they contained photographs, existence of a news-source being used and what questions they tried to answer. The question our research tried to answer is as such; “What are the differences in the 10 most-visited official websites of universities in Turkey and the 10 most-visited official websites of universities in the world in terms of news articles and announcements on their main pages?” We tried to answer our question by evaluating the quantitative data collected by content analysis.

3. FINDINGS
When current articles are analysed, it will be determined that there are no differences in the total number of the most-visited official university websites abroad and in Turkey. There are 95 published current articles in the world’s most-visited official university websites and 96 published current articles in Turkey’s most-visited official university websites. However, there are major differences in types of these articles. News pieces are prominent in the world’s most-visited official university websites, and announcements are prominent in Turkey’s most-visited official university websites.

<table>
<thead>
<tr>
<th></th>
<th>News</th>
<th>for Events pertaining to Support Services</th>
<th>Official</th>
<th>Condolatory Messages</th>
<th>Transcripts of Opening Speeches</th>
<th>University in the News</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 most-visited official university websites of the world</td>
<td>40</td>
<td>34</td>
<td>-</td>
<td>-</td>
<td>7</td>
<td>-</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>10 most-visited official university websites of Turkey</td>
<td>10</td>
<td>51</td>
<td>8</td>
<td>14</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 1-Distribution of articles published on University official websites

While there were 40 news articles and 34 announcements in the world’s most-visited official university websites, while there were 10 news articles and 74 announcements in Turkey’s most-visited official university websites. University websites also contain news articles where the name of the university appears in social communication media. It was noticed that there were 6 times where a news article from a social communication media was used on the 10 most-visited official university websites abroad, and there were once where a news article from social communication media was used on the 10 most-visited official university websites in Turkey. Messages of Presidents pertaining to current topics and events were also included on the 10 most-visited official university websites the world. This is not a practice for most-visited official websites of Turkish universities. One website contains the transcript of a speech previously made by the Rector of the university.

<table>
<thead>
<tr>
<th></th>
<th>News</th>
<th>Current announcements</th>
<th>Photograph with Captions or explanations</th>
<th>Photograph</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 most-visited official websites of universities abroad</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>10 most-visited official websites of universities in Turkey</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 2- Types of first photographs published on the main pages of official websites of universities

Secondly the first photographs that are published on the main pages of official websites of universities have been analysed and categorized. 4 photographs published on the 10 most-visited official websites of universities in the world were related to news articles and the 2 were related to current announcements. Other 4 were taken at
different locations of the campus. 3 photographs out of 4 contained caption/explanations, and 1 was published without any caption.
Upon closer look, the fact that none of the first photographs were news-related on the 10 most-visited official university websites in Turkey, and one was related to a current announcement. Other 9 were taken at various locations of the campus without any caption/explanation.

<table>
<thead>
<tr>
<th>Analysis of the News in terms of what question they answer.</th>
<th>1-Who are we?</th>
<th>2-What do we accomplish with our studies?</th>
<th>3-What types of studies do we work on? What services do we offer?</th>
<th>4-The infrastructure, life on campus and support services?</th>
<th>5-Who are the academic staff? What are their work ethics?</th>
<th>News where perspectives of a news source is being used</th>
<th>Number of news related to hot agenda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of News</td>
<td>40 (29 with photos)</td>
<td>2</td>
<td>17 (12 with photos)</td>
<td>10 (9 with photos)</td>
<td>10 (7 with photos)</td>
<td>1 (1 with photos)</td>
<td>32</td>
</tr>
<tr>
<td>10 most-visited university websites in the world</td>
<td>10</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>10 most-visited university websites in Turkey</td>
<td>10</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 3- News published on the main page of official websites of universities

When main pages of 10 most-viewed official university websites of the world are viewed, it is determined that 29 of the 40 news articles are published with photos. On the other hand; when main pages of 10 most-viewed official university websites of Turkey are viewed, it is determined that none of the 10 news that are published on the main page contained any photos. This proves that 10 most-viewed official university websites of the world support current news with photos and are prepared in a more effective way in drawing the visitors’ attention.

Which of the questions in section one were answered by analysing the news published on the main pages of 10 most-viewed official university websites were tried to determine. According to this; it was determined that 17 of the 40 news articles answered question (2) “What do we accomplish with our studies?”, 10 answered question (3) “What types of studies do we work on?” / “What services do we offer?”, 10 answered question (4) “The infrastructure, life on campus and support services.”, 1 answered question (1) “Who we are?”, and 1 answered question (5) “Who are the academic staff?” / “What are their work ethics?”

The questions answered by 10 news articles published on the 10 most-viewed official university websites of Turkey are: 3 of them answered question (3) “What types of studies do we work on?” / “What services do we offer?” 2 of them answered question (4) “The infrastructure, life on campus and support services.”, 2 of them answered question (5) “Who are the academic staff?” / “What are their work ethics?”

From these numbers, we can draw the conclusion that the current news published on the 10 most-viewed official university websites are mostly prepared in order to answer question (2) “What do we accomplish with our studies?” Current news articles also are used frequently in order to answer question (3) “What types of studies do we work on?” / “What services do we offer?” and question (4) “The infrastructure, life on campus and support services.” Usage of these news in conjunction with photographs, allows the visiting audiences to notice these news easily.

There are 32 news articles that are published on the 10 most-viewed official university websites that contain the opinion of news source among university staff. This shows that university websites also try to convey messages of university staff through current news. When a content-analysis is done on these news articles, it will be noticed that 6 of the articles were about the 9.0 earthquake that struck Japan and the subsequent tsunami
that took place on March 12, 2011 one day before the analysis was done. 3 of the 6 news articles published on the
website answered question (3) “What types of studies do we work on?” / “What services do we offer?” and 3 of them answered question (4) “The infrastructure, life on campus and support services”. This shows that 6 of the 10 most-visited official university websites of the world let their visitors reach news that concern the entire world, and information given by the university on these events.

When the 10 news articles that are published on the main page of the 10 most-visited official university websites in Turkey are examined, we can see that none of it appears on the main page with photographs. News articles are not supported by photographs in order to be perceived by the visitor in an easier way. 3 of the news answer question (3) “What types of studies do we work on?” / “What services do we offer?”, 2 of them answer question (2) “What do we accomplish with our studies?”, 2 of them answer question (4) “The infrastructure, life on campus and support services?”, and 2 of them answer question (5) “Who are the academic staff?” / “What are their work ethics?”, 1 answer question (1) “Who are we?” 6 news articles contain opinions of a news source among university staff. There are no mentions of the earthquake in Japan or other actual events among the news articles.

<table>
<thead>
<tr>
<th></th>
<th>Number of current announcements</th>
<th>1-Who are we?</th>
<th>2-What do we accomplish with our studies?</th>
<th>3-What types of studies do we work on? What services do we offer?</th>
<th>4-The infrastructure, life on campus and support services?</th>
<th>5-Who are the academic staff? What are their work ethics?</th>
<th>9-What are methods of admission to the university?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>10 most-visited university websites in the world</strong></td>
<td>Event announcements</td>
<td>34(13 with photos)</td>
<td>-</td>
<td>5 (3 with photos)</td>
<td>29 (10 with photos)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Official announcements</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Condolatory announcements</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td><strong>10 most-visited university websites in Turkey</strong></td>
<td>Event announcements</td>
<td>51</td>
<td>-</td>
<td>26 (1 with photos)</td>
<td>25</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Official announcements</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Condolatory announcements</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 4- Announcements published on the main page of official university websites

When we compare announcements published on main pages of official university websites; we can see that 10 most-visited official university websites of Turkey have a lot more current announcements than the 10 most-visited official university websites abroad.

While 10 most-visited websites of the world only have announcements pertaining to events, 10 most visited websites of Turkey have announcements pertaining to support services, official announcements, and condolatory announcements, aside from announcements pertaining to events.

13 of the 34 current announcements (38%) published on the 10 most-visited official university websites of the world are published with photographs. On the other hand, only 1 of the 74 current announcements (1.3%) published on the 10 most-visited official university websites in Turkey appear along with photographs. This shows that, when compared with Turkish university websites, announcements appearing on the 10 most-visited official university websites of the world are supported by photographs and that photographs are utilized to attract the visitors’ attention on a very high rate.
29 of the current announcements that are published on the 10 most-viewed official university websites of the world answer question (4) “The infrastructure, life on campus, and support services.”, and 5 of them answer question (3) “What types of studies do we work on?” / “What services do we offer?”

36 of the current announcements that are published on the 10 most-viewed official university websites of Turkey answer question (3) “What types of studies do we work on?” / “What services do we offer?” 30 of them answer the question (4) The infrastructure, life on campus, and support services?”, 7 of them answer question (5) “Who are the academic staff?” / “What are their work ethics?”, and 1 of them answer question (9) “What are the methods of admission into the university?”

| Distribution of messages from University administrators pertaining to current matters they try to answer |
|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|
| Total of messages                                        | 1-Who we are?                                            | 2-What do we accomplish with our studies?                  | 3-What types of studies do we work on? What services do we offer? | 4-The infrastructure, life on campus and support services? | 5-Who are the academic staff? What are their work ethics? | 9-What are methods of admission into the university?  |
| 10 most-visited official university websites of the world | 7 (5 with photos)                                        | -                                                        | 1 (1 with photos)                                             | 3 (3 with photos)                                        | 1                                                        | 1 (1 with photos)                                             |
| 10 most-visited official university websites of the world | -                                                        | -                                                        | -                                                            | -                                                        | -                                                        | -                                                            |

Table 5- Messages published on the main page of the official university websites from the university administrators pertaining to current topics

As opposed to 10 most-visited official university websites in Turkey, 10 most-visited official websites of the world publish messages from high-ranking university administrators pertaining to current topics. 7 messages of this type in our message were detected. 5 of these messages were published along with photographs. 3 of them were pertaining to the earthquake in Japan and the Tsunami. It is seen that high-ranking administrators at the university are in an effort to link direct communication with their audiences through messages they publish on their official websites.

3 of these messages answer question (4) “The infrastructure, life on campus and support services?”, 1 answers question (2) “What do we accomplish with our studies?”, 1 answers question (3) “What types of studies do we work on?” / “What services do we offer?”, 1 answers question (5) “Who are the academic staff?” / “What are their work ethics?” and 1 answers question (9) “What are methods of admission into the university?”
University official websites not only publish news articles prepared by under the umbrella of university, but they also publish news articles prepared by the mass media on their websites. 6 news articles prepared and published by the mass media were included on the 10 most-visited university websites of the world. All of the news articles answer question (3) “What types of studies do we work on?” / “What services do we offer?” 1 of them is about the earthquake disaster in Japan. Only 1 news article prepared and published by the mass media was included on the 10 most-visited university websites in Turkey. This news articles answer question (2) “What do we accomplish with our studies?” From these findings, it can be said that information about what types of studies are done within the body of the university, what is produced as a result of these studies can be reached by target audiences through news stories prepared by mass media published on the main pages of official university websites.

4. ARGUMENT AND CONCLUSION
In this research, most-visited official university websites in Turkey have been compared with the most-visited official university websites in the world in respect to published current news and announcements. The purpose of the research was to find an answer to the question “what are the differences in the 10 most-visited official websites of universities in Turkey and the 10 most-visited official websites of universities in the world in terms of news articles and announcements on their main pages?” with an evaluation of quantitative findings gathered through content analysis. The most important tool on the main page of official websites of universities is the biggest photograph used on the top of the page. This photograph that is the important element in explaining the purposes of the institution’s works, its works in progress, its work ethics, infrastructure and, most importantly, its success gained through its works to the masses is not utilized effectively on the 10 most-visited official websites of universities in Turkey.

It was determined that out of the photographs appearing on the first pages of the world’s 10 most-visited official university websites, 4 were related to news articles, 2 were related to current announcements, 3 were taken at various locations around the campus with no explanations beside them while only one was a photograph with no explanation at all. On the other hand, out of the photographs appearing on the first pages on 10 most-visited official university websites in Turkey, 1 was related to a current announcements, and 9 were photographs taken at various locations around the campus with no explanations at all. This means that the photographs seen by the visitors when they first reach the main pages of the 10 most-visited official university websites in Turkey are out of date. Furthermore, lack of a caption or an explanation with these campus photos makes it harder for visitors to understand the content.
to assign any value to these. Many events that take place on campus are not conveyed effectively and the university image comes across as a stagnant one, as opposed to a dynamic one. When analysed quantitatively, predominantly news articles appear on the world’s most-visited official university websites; meanwhile, predominantly announcements appear on Turkey’s most-visited official university websites.

Current news and announcements are supported visually in order to draw the visitors’ attention on the world’s 10 most-visited websites of universities. It is seen that, while 29 news articles of the 40 that appear on the main pages of the 10 most-visited official university websites of the world contain photos, none of the 10 news articles that appear on the main pages of the 10 most-visited official university websites in Turkey contain any photographs. A similar situation is observed in current announcements. 13 of the 34 current announcements that appear on the main pages of the 10 most-visited official university websites of the world contain photographs. On the other hand, only 1 announcements out of the 74 existing ones on main pages of the 10 most-visited official university websites in Turkey contain photographs.

It is seen that current news articles appearing on the 10 most-visited official university websites of the world are included mainly to answer question (2) “What do we accomplish with our studies?” 17 of the 40 news articles published on the main pages give an answer to this question. 12 of these 17 articles appear on the main page along with photographs. When evaluated in terms of the question they answer, news articles appearing on the main pages of the 10 most-visited university websites on the Internet in Turkey do not focus on one question. The most effective way for an institution, to explain to the visitors of their websites what they accomplish with their efforts, is preparing comprehensive news articles that pertain to successes they have achieved. The best method to make these articles more appealing to the website visitors is to publish them on the main page along with photographs. However, it is seen that this method is not used on the 10 most-visited university websites in Turkey as effectively as it is used on the 10 most-visited university websites in the world.

Both 10 most-visited university websites in Turkey and abroad use news articles to publish messages of the academes. More than half of these news articles are published with a news source among the academes.

6 of the news articles that were published on the 10 most-visited university websites in the world pertained to the 9.0 earthquake that struck Japan and the subsequent Tsunami that took place on March 12, 2011, one day before the research was done. This shows that the visitors of 6 out of the 10 most-visited university websites in the world can reach information given by these universities pertaining to a current event that concerns the whole world. There were no news articles that were published on Turkish university websites that pertained to the earthquake that struck Japan or any other current events.

It is observed that high-ranking university administrators use their official websites to build direct communication with their target population. As opposed to their Turkish counterparts, the 10 most-visited university websites in the world include messages from high-ranking administrators pertain to matters at hand. 5 of these 7 messages are included on the main page along with photographs. The 10 most-visited university websites in Turkey and abroad can communicate to their target population, what types of studies are done within the university and what is accomplished as a result of these studies by publishing news articles on their websites that are prepared by mass-media.

Corporate websites have become indispensable tools of public relations with their ever-increasing importance parallel to increasing Internet users. Corporate websites have the potential to answer needs and desires of various target populations, if managed professionally. Design of the corporate website and preparation of the published content are just as important as technical infrastructure in order to unlock this potential. Problem of communicating their messages to their target populations have become history with corporate websites. The biggest problem at this point is the preparation of messages that will be published on these websites in a way that will be in accordance with the purposes of the institution, as well as needs and desires of their target population.

With their corporate websites, corporations not only have a new public relations tool, but a new media organ that is active 24/7; furthermore, corporations should work like news agencies in order to utilize this potential. Persons responsible with this field, should approach this topic professionally, prepare a broadcasting policy for the corporate website that is in accordance with the purposes of the institution and needs and desires of their target population, build a communication network between the institution and its target population which will notify them of current events, research information, evaluate this information, and prepare these articles in a language that will make it more interesting and easier to understand by the target audiences. These texts should
be supported visually with pictures, photographs and videos. Texts that are published on the websites should be updated with changes with the subject matter and/or should be removed from the main page and archived.

Universities are included in these institutions that use corporate websites. Websites that can help universities build a more effective communication with societies and also have a potential to bring academic knowledge to society’s agenda more often. In today’s mass media, where scientific news and news prepared with a scientific approach are not published enough; universities can help fill this hole by sharing their accumulation of knowledge with society through their official websites.

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