AN INVESTIGATION OF PRIMARY SCHOOL SCIENCE TEACHERS' USE OF COMPUTER APPLICATIONS

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ABSTRACT
This study investigated the level and frequency of science teachers' use of computer applications as an instructional tool in the classroom. The manner and frequency of science teachers' use of computer, their perceptions about integration of computer applications, and other factors contributed to changes in their computer literacy are investigated in this study. 63 primary school science teachers from the Northwestern part of Turkey participated in this study. A survey was administered to teachers. Results demonstrated that improving the computer literacy of science teachers seems to increase science teachers' computer use and consequently increase their integration of computer applications as an instructional tool. Internet, email, and educational software CDs found to have high percentage in teachers' use of computer applications in the classrooms. Also, the results indicated gender difference exists between science teachers' integration of computer applications as an instructional tool.

Key Words: Computer Literacy, Integration of Technology, Science Education

INTRODUCTION

Research explicitly reports that science education and computer technology created a meaningful partnership over the century (Flick, & Bell, 2000). The introduction of computer technology took place in science education as a tool for learning science content and processes and as a topic of instruction in itself (National Research Council [NRC], 1996). Computer-based instruction also influenced teacher education that many science teachers reviewed their teaching methods based on theories of student learning. The speed, flexibility, and storage capacity of computers caused science teachers to redefine the meaning of hands-on experience and re-think to teach science concepts with computers. National Science Education Standards (NRC, 1996) clearly indicated that computer-based technology should be integrated in the context of science content and science education should take advantage of the unique features of computer technologies.

Although research favors the use of computers in the classroom instruction, many studies showed that computer technologies are not used efficiently by the majority of teachers (Pepper, 1999; Abdal-Haqq, 1995). Thomas (2001) argues that still little is known about the computer use in science classrooms and its effects on students' learning. Teachers' lack of training and limited access to technology are the main reasons for the low level of computer use in classrooms (Bosh & Cardinale, 1993; Topp, Mortensen, & Grandgenett, 1995). Okinaka (1992) found that teachers are aware of the complexity of computers and when it comes to teach a subject with the computer, many teachers feel uncomfortable. Additionally, Dexter, Anderson, & Becker (1999), in their study with 47 teachers from twenty K -12 schools across the three states, found that teachers must have opportunities to construct pedagogical knowledge in a supportive environment in order for teachers to implement computer technology in instruction. Teachers indicated computers helped them to change but teachers did not acknowledge computer as the cause of the change. On the other hand, Kinzie & Delcourt (1991) found that teachers who use computer technology more efficiently are more likely to be a model for the students, helping students to produce positive attitudes toward the computers.

Results of Halpin (1999)'s study on 73 preservice teachers indicated that the integration of computer literacy in method courses provided prospective teachers confidence to transfer their computer skills into their classrooms based on their own explanatory experiences. Moreover, Guha (2000), in her qualitative study with 10 elementary teachers, found that teachers wanted to be competent in using computers and instruction as they could see positive changes in teaching strategies as a result of using this technology. In addition, over the past decade there has been a great deal of research into gender and science. Studies have indicated that gender significantly influences many attributes related to computer use. Butler (2000) and Woodrow (1992) found that males have a higher degree of computer enthusiasm than do females and concluded that the lower computer confidence among females may restrain female teachers from using computers in science. There may be a certain degree of ability and understanding needed before a science teacher will be interested in using and promoting computers. Indeed,

Gos (1996) suggested that the lack of computer experience among female teachers may be a contributing factor to their passive role toward computer integration.

The literature indicates that gender has a strong impact on teachers` attitudes toward computers in science courses. Some studies suggest that male teachers tend to show slightly more favorable attitude toward computer use than do females (Dupagne, & Krendi, 1992; Ertmer, Addison, Lane, Ross, & Woods, 1999). Other studies, however, report little or no differences in teacher attitudes on the basis of gender (Koszalka, 2001; Kramer, P.E., & Lehman, 1990). In general, age appears to have an impact on attitudes toward computers, the level of knowledge about computers, and willingness to use computers.

PURPOSE OF THE STUDY

The purpose of this study was to further examine associations among science teachers' perceptions about the integration of computer applications as an instructional tool, frequency of their computer use and their level of computer literacy. The literature suggests that gender should be taken into account when examining the integration of computer applications in the instruction. Thus, science teachers' integration of computer applications as an instructional tool was compared based on the gender as a secondary purpose of the study. Based on the purposes of the study, following research questions were formulated and addressed in this study:

1. Is there a relationship between science teachers' level of computer literacy and their frequency of computer use?
2. Is there a relationship between science teachers' level of computer literacy and integration of computer applications as an instructional tool?
3. Is there a relationship between frequency of science teachers' use of computer and integration of computer applications as an instructional tool?
4. How do gender differences play a role in science teachers' integration of computer applications as an instructional tool?

METHOD

Participants

The snowball sampling was utilized to identify participants for the study. Science teachers who worked in the primary schools located in one of the Northwestern provinces of Turkey were selected to collect data. There were 153 science teachers working in the province at the time when the study conducted. Initially face-to-face meetings were arranged with science teachers and their participation to the study was sought. Science teachers were asked to locate other science teachers in the face-to-face meetings. Contact information including phone numbers, emails and mail addresses of prospective participants were obtained in the face-to-face meeting. Participation of other science teachers was sought using obtained contact information. The total of 63 science teachers agreed to participate in the study which is an acceptable sample size when the confidence level is 95% and the confidence interval is 10.

Instrument

A survey developed by Demiraslan and Usluel (2005) was adapted for the data collection in this study. This survey was used in earlier research studies and had an established content validity. The adapted survey had four sections. The first section of the survey was used to collect demographic information. The second part of the survey was used to obtain science teachers' level of using computer applications with ten questions with response categories ranging from "Never" to "Very High". The third section of the survey was used to collect information about the frequency of science teachers' use of computer applications with ten questions. The last section of the survey was used to collect information on science teachers' perceptions about the integration of computer applications as an instructional tool with six questions with response categories ranging from "Strongly Disagree" to "Strongly Agree". Numbers from 1 to 5 were assigned to the scale responses since items were worded in both directions. The survey approximately took 20 minutes to complete.

Data Collection

Surveys were delivered to 63 science teachers agreeing to participate in the study. 30% of the participants preferred to receive and complete the surveys on their schools. Surveys were delivered to and collected from these participants by visiting their schools personally. 44% of the participants preferred to complete the surveys on the phone and remaining participants preferred to receive and complete the surveys via emails.

Data Analysis

Collected surveys were reviewed for any errors and no error was found. Data were ported into the statistical analysis package (SPSS 13) for further analysis. Descriptive analysis, correlational analysis and One-Way

ANOVA were conducted for the data analysis in order to investigate research questions.

RESULTS

Background information of the teachers included gender and computer experiences of participants. Approximately half of the teachers responding to the survey were female (46%). Ninety five percent of the teachers responding to the survey indicated that they were using the computer. Participants' teaching experience varied from 1-3 years to over 15 years. Accordingly, as seen in Table 1, only 6.5% of the teachers indicated that they had experience with computers more than 15 years, while 35% of teachers indicated 4-7 years of computer experience.

Table 1: Computer Experience of Participants

Computer Experience	1-3 years	4-7 years	8-11 years	12-15 years	>15 years
	13%	35%	33.3%	13%	6.5%

As indicated in Table 2, regarding the level of science teachers' use of computer applications, internet (49.2%), email (47.6%), and educational software CDs (14.3%) were scored as high level of use. Other software programs like word processing (34.7%), spread sheets (36.5%), desktop publishing (36.5%), and presentation (30.2%) were scored as medium level of use. Moreover, graphics and drawing programs (47.6%), word processing (28.2%), spread sheets (28.6%), database programs (23.8%) and graphic and drawing programs (23.8%) were indicated as "never been used by science teachers". Results indicated that relationship between level of science teachers' use of computer applications and their frequency seems to be symmetric. That is, regarding the frequency of using computer applications, the Internet (%49.2), emails (%47.6), and educational software CDs (%14.3) were indicated as applications used most frequently by the teachers (see Table 3).

Table 2: Level of Using Computer Applications

	Never		Low		Medium		Medium-high		Very high	
	f	%	f	%	f	%	f	%	f	%
Word processing	18	28.6	16	25.4	20	31.7	8	12.7	1	1.6
Spread sheets	18	28.6	14	22.2	23	36.5	8	12.7	0	0.0
Database programs	15	23.8	22	34.9	17	27	8	12.7	1	1.6
Graphics and drawing programs	15	23.8	14	22.2	21	33.3	12	19.0	1	1.6
Desktop publishing	12	19.0	15	23.8	23	36.5	10	15.9	3	4.8
Presentation programs	8	12.7	8	12.7	19	30.2	21	33.3	7	11.1
Educational CDs	3	4.8	7	11.1	17	27	27	42.9	9	14.3
Email	1	1.6	4	6.3	13	20.6	15	23.8	30	47.6
Internet	1	1.6	2	3.2	12	19.0	17	27	31	49.2
Others	6	9.5	14	22.2	32	50.8	10	15.9	1	1.6

Table 3: Frequency of Using Computer Applications

	Never		Low		Medium		Medium-high		Very high	
	f	%	f	%	f	%	f	%	f	%
Word processing	25	39.7	12	19	22	34.9	4	6.3	0	0
Spread sheets	26	41.3	12	19	14	22.2	10	15.9	1	1.6
Database programs	24	38.1	15	23.8	15	23.8	9	14.3	0	0
Graphics and drawing programs	22	34.9	11	17.5	14	22.2	15	23.8	1	1.6
Desktop publishing	19	30.2	13	20.6	16	25.4	13	20.6	2	3.2
Presentation programs	13	20.6	12	19	16	25.4	17	27	5	7.9
Educational CDs	7	11.1	14	22.2	11	17.5	22	34.9	9	14.3
Email	1	1.6	16	25.4	8	12.7	13	20.6	25	39.7
Internet	2	3.2	10	15.9	14	22.2	8	12.7	29	46
Others	20	30.7	10	15.9	25	39.7	6	9.5	2	3.2

Table 4 shows the analysis of science teachers' perceptions about integration of computer applications as an instructional tool. Accordingly, 49.2% of the teachers indicated that they agree with designing instructional activities by using computer applications and apply them in the classroom. However, 23.8% of the teachers do not agree with this opinion. 38.1% of teachers reported that they review the Internet resources periodically in order to use them in instructional activities, while 23.8% of teachers do not use internet for that purpose. 47.6%

of the teachers reported that if they use computer applications as instructional tool, then they evaluate the classroom activities in computer applications. Almost half of the teachers (50.8%) indicated that they encourage students to use computer applications in science classrooms. Another important finding was that 44.4% of the participants indicated that they disagree with the statement that "they use traditional methods since they do not know how to apply computer applications in instruction". When science teachers were surveyed about being a model to integrate computer applications, 46% indicated that they tried to be a model for the students. 23.8% indicated that they did not make an effort to be a model for the students.

Table 4: Perceptions about Integration of Computer Applications as an Instructional Tool

	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree	
	f	%	f	%	f	%	f	%	f	%
I design instructional activities using computer applications and apply them in the class.	4	6.3	15	23.8	5	7.9	31	49.2	8	12.7
I evaluate the results of the classes where I used computer applications.	2	3.2	15	23.8	6	9.5	30	47.6	10	15.9
I encourage students to use computer applications in science classes.	1	1.6	17	27	8	12.7	32	50.8	5	7.9
I know how using computer applications will affect students' success and I become a model in this matter.	2	3.2	15	23.8	11	17.5	29	46	6	9.5
I review the internet sources periodically to use in the instruction.	3	4.8	15	23.8	10	15.9	24	38.1	11	17.5
I use traditional methods since I do not know how to apply computer applications in instruction.	28	44.4	9	14.3	9	14.3	17	27	0	0

The Pearson Correlation Coefficients are presented in the Table 5 for the relationships among computer literacy, frequency of computer use, and integration of computer applications. Table 5 and Figure 1 evidently show that relationships between computer literacy and frequency of computer use and the relationship between computer literacy and integration of computer applications are positive. The coefficients of correlations which ranged from +.717 to +.871 showed that about 50% to 70% of the variation computer literacy to integration of computer applications and computer literacy to frequency of computer use can be explained by a positive relationship.

Table 5: Relationship among Computer Literacy, Frequency of Computer Use, And Integration of Computer Applications (CA)

	Computer Literacy	Frequency of Computer use	Integration of CA
Computer Literacy	1	.871	.717*
Frequency of Computer use	.871*	1	.825*
Integration of CA	.717	.825	1

*p< 0.05

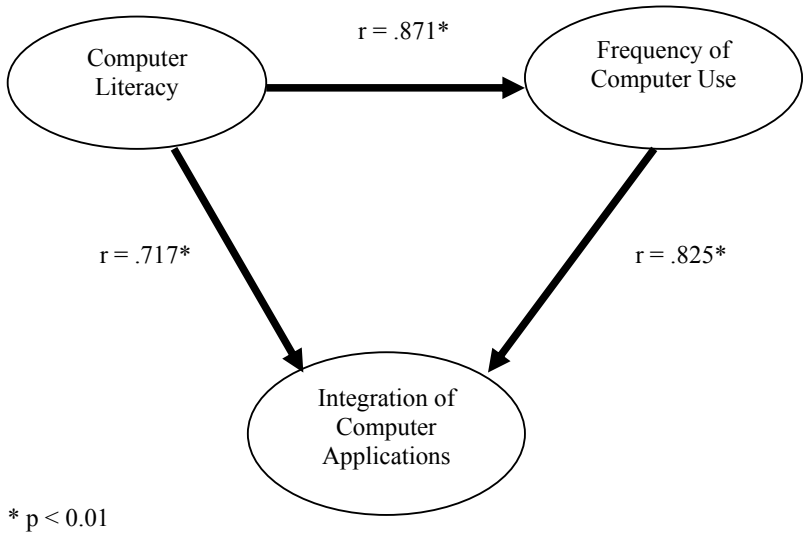

Figure 1: Results of a Correlation Analysis among Computer Literacy, Frequency of Computer Use, and Integration of Computer Applications (CA)

Results of One-way Analysis of Variance investigating the differences in the perceptions about integration of computer applications as an instructional tool for different genders are summarized in Table 5. Means and standard deviations of science teachers with different gender in using computers in the classroom are presented in the Table 6.

Table 5: Source Table for Analysis of Variance

	Between Subject Effects			
Source	SS	Df	MS	F
Between groups	508.820	1	508.820	7.663*
Within groups	4050.609	61	4050.609	
Total	4559.429	62		

*p<0.05

Examination of Table 5 indicated that there is a difference between male science teachers' integration of computer applications and female science teachers' integration of computer applications. Accordingly, as indicated by Table 6, male science teachers' integration of computer applications ($\bar{x}$=32.52) is higher than female science teachers' integration of computer applications ($\bar{x}$=26.82).

Table 6: Means and Standards Deviations for Gender

					95% Confidence Interval			
Gender	N	Mean	SD	Std.Error	L.Bound	U.Bound	Lowest	Highest
Female	29	26.82	9	1.67	23.4	30.25	10	42
Male	34	32.52	7.34	1.25	29.96	35.09	18	47
Total	63	29.9	8.57	1.08	27.74	32.06	10	47

DISCUSSION

Investigating the relationship between science teachers' level of computer literacy and their frequency of computer use, this study found a positive correlation. Science teachers tend to use computers more often as their level of computer literacy increases. Positive correlation was also found between science teachers' level of computer use and the integration of computer applications as an instructional tool. Improving the computer literacy of science teachers seems to increase science teachers' computer use and consequently increase their integration of computer applications as an instructional tool. Teachers' lack of computer literacy seems to be main reason for the low level of computer use as an instructional tool in classrooms (Bosh & Cardinale, 1993; Topp, Mortensen, & Grandgenett, 1995). Literature and positive correlation found in this study showed that improving the computer literacy of science teachers seems to provide more confidence to integrate computer applications as an instructional tool (Halpin, 1999).

23.8% (15) of science teachers disagree with designing instructional activities by using computer applications, while 6.3% (4) of science teachers strongly disagree. By combining "disagree" option with "strongly disagree" option, the ratio of science teachers who do not use computer applications in instructional activities rises to 30.1%. Almost 1/3 of the teachers' negative attitude toward using computer applications in instructional activities indicates that the issue of teachers' use of computers still continues to be a problem. Results of this study showed that most of the Turkish science teachers participated in this study show positive attitude toward using computer applications in instructional activities. These results are contradicted to the results of other researchers' studies conducted in early years (Abdal-Haqq, 1995; Pepper, 1999). The spread of computer applications in schools in recent years could be a reason in the increase of using computer applications in instructional activities.

Consistent with some researchers' findings (Butler, 2000; Woodrow, 1992), this study found that male teachers expressed greater knowledge about computers than female teachers. 23.8% of science teachers indicated that they do not use the Internet resources for their instruction. Results also indicate that many science teachers appear not to have any opportunity to access Internet resources to get updated information or to get alternative resources for their instruction.

CONCLUSION

In general, the findings of this study support the results of other studies conducted in this area (Kramer & Lehman, 1990; Harris & Grandgenatt, 1996). Accordingly, the popular use of computer technology among science teachers is the indicator that science teachers assign computers a crucial role in students' understanding of science. Computers give teachers different opportunities to look at science topics from different aspects. It seems that effective use of computer technology in science classrooms would be expected from all science teachers in the future. Some teachers might think that over-reliance on the computers can be a problem for students. Computers could be used mechanically, and student's understanding might prove superficial in simple science topics. This may explain the lack of computers usage among science teachers (Cooney &Wilson, 1996). However further studies should be conducted to confirm this assumption. According to this study, 50.8% of the teachers reported that they encourage students to use computer applications in science classes. However it should be noted that many teachers may feel that students become too dependent on the computer programs and are thus unable to master basic science topics (Schmidt, & Callahan, 1992). It would be interesting to see how using the computer enables teachers to use the complexity of knowledge in instruction. Therefore, more research comparing the technology use of teachers based on the gender difference is needed to understand how science teachers work with computers and use them as a learning tool in the classroom.

REFERENCES

Abdal-Haqq, I. (1995). Infusing technology into preservice teacher education. Washington, D.C.: Office of Education Research and Development. ERIC Educational Document (ED 389699).

Bosch, K.A.,& Cardinale, L.(1993). Preservice teachers' perceptions of computer use during field experience. *Journal of Computing in Teacher Education*, 10(1), 23-27

Butler, D. (2000). Gender, Girls, and Computer Technology: What's the Status Now? Clearing House, 73(4), 225-230.

Demiraslan, Y. & Usluel, Y. K. (2005, July). Bilgi ve iletişim teknolojilerinin öğrenme öğretme sürecine entegrasyonunda öğretmenlerin durumu. *The Turkish Online Journal of Educational Technology*, 4 (3), Article 15. Retrieved from http://www.tojet.net/articles/4315.htm.

Dexter, S., Anderson, R. E., & Becker, H. J. (1999). Teachers' views of computers as catalysts for changes in their teaching practice. *Journal of Research on Computing in Education*, 31 (3), 221-239.

Ertmer, P., Addison, P., Lane, M., Ross, E., & Woods, D. (1999). Examining teachers' beliefs about the role of technology in the elementary classroom. *Journal of Research on Computing in Education*, 32(1), 54- 72.

Flick, L., & Bell, R (2000). Preparing tomorrow's science teachers to use technology: Guidelines for Science educators. *Contemporary Issues in Technology and Teacher Education*, 1(1), 39-60.

Gos, M. W. (1996). Computer anxiety and computer experience: A new look at an old relationship. Clearing House, 69(5), 271-277.

Guha, S. (2000). Are we all technically prepared? Teachers' perspective on the causes of comfort or discomfort in using computers at elementary grade teaching. Atlanta, GA: The Annual Meeting of the National Association for the Education of Young Children. ERIC Educational Document (ED 456101).

Halpin, R. (1998). Computer literacy taught through student-centered activities in elementary teacher education: constructivist theory put into practice. San Diego, CA: The National Educating Computing Conferenc. ERIC Educational Document (ED 419498).

Harris, J. B., & Grandgenett, N. (1996). Correlates among teachers' anxieties, demographics, and telecomputing activity. *Journal of Research on Computing in Education*, 28(3), 300-318.

Hunt, N.P., & Bohlin, R.M.(1993). Teacher education students' attitudes toward using computers. *Journal of Research on Computing in Education*, 25 (4), 487-497.

Kinzie, M.B., & Delcourt, M. A. (1991). Computer technologies in teacher education: The measurement of attitudes and self-efficacy. Chicago, IL: Annual Meeting of the American Educatinoal Research Association. ERIC Educational Document(ED331891)

Kramer, P.E., & Lehman, S. (1990). Mismeasuring women: A critique of research on computer ability and avoidance. *Signs: Journal of Women in Culture and Society*, 16(1), 158-72.

Koszalka, T. A. (2001). Effect of Computer-Mediated Communications on Teachers' Attitudes toward Using Web Resources in the Classroom. *Journal of Instructional Psychology*, 28(2), 95- 103.

National Research Council. (1996). *National science education standards*. Washington, D.C.:
Author.

Okinaka, R. (1992). The factors that affect teacher attitude toward computer use. ERIC Educational Document (ED346039).

Pepper, K. (1999). A Comparison of attitudes toward computer use of preservice and inservice teachers. Point Clear, AL: The Annual Meeting of the Mid-South Educational Research Association. ERIC Educational Document (ED 436525).

Thomas, G.P.(2001). Toward Effective Computer Use in High School Science Education: Where to from Here? *Education and Information Technologies*, 6(1), 29-41

Topp, N. W., Mortensen, R.,& Grandgenett, N.(1995). Building a technology—using faculty to facilitate technology-using teachers. *Journal of Computing in Teacher Education*, 11(3), 11-14.

Whitley, B. E. (1996). Gender differences in computer-related attitudes: It depends
on what you ask. *Computers in Human Behavior*, 12 (2), 274-289.

Woodrow, J. E. J. (1992). The Influence of Programming Training on the Computer Literacy and Attitudes of Preservice Teachers. *Journal of Research on Computing in Education*, 25(2), 200-220.