# META ANALYSIS OF THE COMPUTER ASSISTED STUDIES IN SCIENCE AND MATHEMATICS: A SAMPLE OF TURKEY

Asst. Prof. Dr. Mustafa YEŞİLYURT
YYU Educational Faculty
afra65@yahoo.com

**ABSTRACT**
Because of being a developed country which is a phenomenon among the countries in the world, this desire inevitably has contributed the scientific and technological developments in educational areas as well. The expectation of these scientific and technological changes reflections in teaching areas to form permanent learning has developed the use technology in education. The use of computer in educational areas increases in our country together with the developed countries. Computer assisted instruction is mostly used in academic studies that investigate the success of difference and it is known to use control and experimental groups in these experimental studies. Meta-analysis summarizes the results of various studies in the fields of science and aims at reaching common judgment by combining the conclusions. The purpose of this study is to obtain a general opinion about effectiveness of taught courses which are carried out by using Computer-Assisted Instruction in Science and Mathematics in our country by using meta-analysis method. That is, meta-analysis method was used to combine the similar studies and to determine the mean effect of the Computer Assisted Instruction (CAI). The most important result of this study is that the Computer Assisted Instruction has an important level of superiority.

## INTRODUCTION

It has been a prerequisite for countries to become a more developed country in all areas than other countries in the world. Therefore, competition of production and consumption among the countries is an important area of activity which should be regulated not to damage the quality of social life. Providing of the dizzy technological development in the world to improve people's life quality in fast and permanent way should be the most important activity area of the countries. Moreover, it's thought that there are important contributions of results and suggestions of scientific researches in Science and Mathematics being integrated into the life of the communities on the basis of technological growth (Karalar and Sarı, 2007). The expectation of these scientific and technological changes reflections in teaching areas to form permanent learning has developed the use technology in education.

Contributions of technology to educational areas are increasing to use of equipments and provide scientific researches to achieve positive results more quickly. It develops to use of technology in education that the expectation of this scientific and technological change's reflections in teaching areas which are aimed at making up more permanent learning. Similar developments are recorded in our country.

Therefore, the use of equipment, laboratory and computer in education is quickly replicated because of triggered developments in educational technology. Using computer in educational areas is growing up together with developed countries and it can be observed by looking at classrooms virtually in our country.
Technological applications in education have improved in various ways. The computer-use software in Science and Mathematics, computer use animations, computer use integrated experiment simulations are leading technological applications of performing important and permanent learning. Therefore, the use of computers provides significant contributions in Science and Mathematics. Apart from these, it has been seen that computers create statistical differences in experimental works which computers are involved as technology of providing support teaching areas.

In that case, Computer assisted instruction is a teaching method that has consisted of self-learning principles. Hence computer is used as a platform of learning to occur, to strengthen the process of teaching and student motivation. So, students can benefit from considering speeding up their learning by using computer technology. Computer assisted instruction can be defined as activities during which students are interacted with the courses that are conducted in computer. During the process teacher assumes the role of the guide and the computer assumes the role of the platform (Sünbül et al. 2002). Computer assisted instruction is mostly used in studies which use control and experimental groups and looked at the difference of academic achievement.

Meta-analysis can be described as analysis of analyses in the literature studies. Meta-analysis is a method analysis of analyses that combines the results of multiple studies which are made in a specific case and independent from each other. In so doing the statistical analysis findings obtained from studies are compared and combined. Meta-analysis summarizes the results of various studies in the fields of science and provides to reach

 

common judgments by combining the conclusions (Çağatay 1994; Abramson 1994; Akgöz et al, 2004). Therefore, meta-analysis is the method of combining the results of different studies.

Meta-analysis makes analysis of analyses of different studies which give statistical results in a similar way and in the same area in education. In other words, meta-analysis combines the results of studies which give quantitative results and makes analysis statistical results which are reached in these studies.

Various experimental researches in meta-analysis studies are being done in education. Teaching in many fields, especially in the studies which investigate academic achievement meaningful differences are found among groups. Important studies which are searched for meaningful differences between Computer-Assisted Instruction and traditional teaching are being carried out in our country in the fields of science and mathematics like other countries in the world. Meta-analysis of computer-assisted instruction applications and its effectiveness was calculated by Bayraktar (2000) in USA.

**Problem of the Study**
Is there statistical meaningful difference between two methods when Computer-Assisted Instruction applications in Science and Mathematics and experimental studies to measure effectiveness of traditional teaching which carried out between 2002–2008 in our country? This question composes the problem sentence of the research.

**Purpose**
The purpose of this study is to obtain a general opinion about effectiveness of taught courses with meta-analysis method which is carried out using Computer-Assisted Instruction in Science and Mathematics in our country. In addition, it's aimed to investigate whether or not a meaningful difference between Computer Assisted Instruction in Science and Mathematics and traditional teaching in our country when the experimental researches which are performed to consider academic achievement are considered.

**Importance of Study**
This study is important to determine the reason for doing the Computer-Assisted Instruction researches in academic achievement in literature. Also, doing meta-analysis of related researches and to be example of literature studies as being an analysis of analyses is important.

**Limit of Study**
In general, this study is limited to its own characteristics of meta-analysis method which is a method of literature research. The studies which are carried out Computer-Assisted Instruction application with experimental methods in Science and Mathematics between 2002–2008 in our country constitute the boundaries of this research.

**METHODOLOGY**
Chosen for this research and conducted in Turkey some Computer-Assisted Science and Mathematics studies have been examined. Review of these studies meta-analysis has been done to determine the mean effect of the Computer Assisted Instruction (CAI) in academic achievement. Shortly, meta-analytical screening method which allows to combine the results of similar studies in research and to calculate common effect sizes has been used (Ergene, 1999; Akgöz et al, 2004; Şahin, 2005).

**Data Collection**
Firstly, it's seen that the most important search criteria is CAI when considering the type of studies which may be related to this research. Therefore, the Computer- Assisted and Computer-Based content of the studies in Science and Mathematics has been collected to be used in research. In these studies, CAI is usually seen like activities prepared for correcting misconception, instead of laboratory simulation experiments and instead of basic expression of any unit various computer-based presentations which are supported by various visual. In teaching of Biology, Science and Technology, Physics, Chemistry and Mathematics areas, 155 studies whose content is CAI were compared between experimental and control groups. The collection of these studies has also been examined in term of whether or not CAI method contributes to students' academic achievement.

**Process Order**
It has regarded that experimental or quasi-experimental related studies have to be compared to determine academic success of students in terms of CAI. It has been decided that totally 25 studies are included in research having 't' or 'F' test findings. 2 of the studies are master thesis, 4 of them are academic paper and 19 of them are articles published in scientific journals. In addition, two different 't' findings in three studies and three different 't'

 

findings in one study were given. Thus, 30 different evaluable findings have been reached totally out of 25 studies.

**Encoding process**

The number of students, experimental group mean, standard deviation of the experimental group, control group mean, standard deviation of control group, t values and p values of 30 evaluable studies have been coded. In addition, publication date and the authors' names of these studies were also included in the encoding. These encoding processes have also been done for pre-test findings of related studies. However, in a study Sünbül and his friends have done in (2002), although pre-test findings have been given for two different data, pre-test finding has not been given for third data.

**Data analysis**

Mean Difference Effect meta-analysis has been used in this research to calculate mean differences between experimental and control groups in experimental studies. It is seen necessary that data of different studies are converted to a common effect size indicated by MD.

Table1. Formulas of Effect Size and Table of Conversion

| Statistics | Effect size (MD) formulas of conversion | Explanation |
|---|---|---|
| Means | $MD = Me - Mc$ | $M_e$=mean experimental group<br>$M_c$=mean control group |
| Variances | $Sp^2 = \frac{(Ne-1)Se^2 + (Nc-1)Sc^2}{(Ne+Nc-2)}$ | Ne=participants experimental group<br>Nc= participants control group<br>$S_e^2$=variance experimental group<br>$S_c^2$=variance control group |

The conversion formulas are given in Table 1. for Effect Size (MD). MIX-Version 1.7 (Meta-Analysis Made Easy) package program was used in the meta-analysis of the recorded data from related studies.

**Findings and Discussions**

Total of 30 data sets of 25 experimental researches which are suitable for determining criteria and to measure effectiveness of the CAI studies conducted in our country were combined with meta-analysis method. Numerical and graphical results are listed for 30 data set of 25 related experimental studies.

Table 2. Meta-analysis findings calculated with MIX package program.

| Heterogeneity | df | Mean Effect Size (Meta-Analysis Outcome) | 99% CI |
|---|---|---|---|
| Q total 259,8178 | 29 | E++ 3,8383 | 3,3745 to 4,3020 |

Findings of the heterogeneous test are seen in Table 2. Accordingly, it is understood that related studies are homogeneous at the critical level of 0.01 and can be combined. Average Effect Size is the positive value of E + + = 3,8383 and Computer Assisted Instruction is seen more successful than traditional teaching amount the value of +3,8383.

**Normal Quantile Plot**

The plot looks like the normal distribution while distribution of data approach to X = Y line. It is understood that effect size data distribution approaches to x-y line that looks like the normal distribution on the graph in Figure 1. Getting an appearance similar to the normal distribution from effect size dataset graph sets thinking related data are suitable to use for calculation of the total effect size.

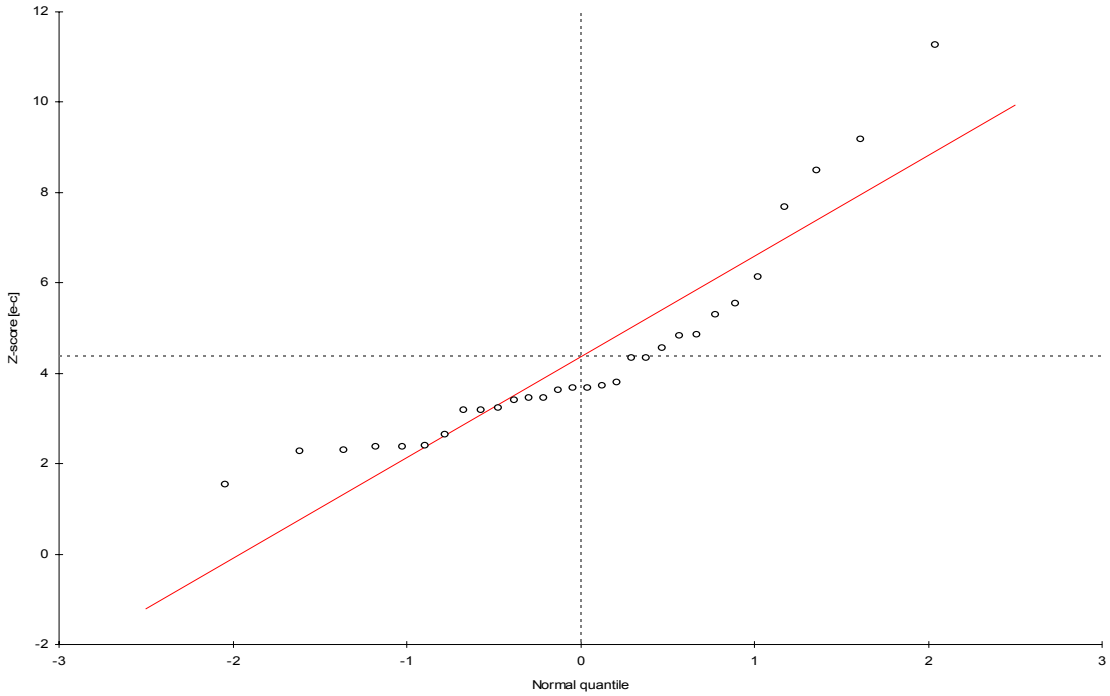


Figure 1 Normal Distribution Graph (Normal Quantile Plot)

**Effect Sizes and Distribution of Rejection Sensitivity (Exclusion Sensitivity Plot)**

The graph of Effect Size (MD) and the Rejection Range is seen in Figure 2. The related distribution doesn't show symptoms of heterogeneous like any fluctuations and deviation. Therefore, it's seen that data set of Average Difference Effect Size is a research figure which has homogeneous properties. In addition, according to this chart it's clear that all the MD values are positive and as a whole has a consistent distribution.

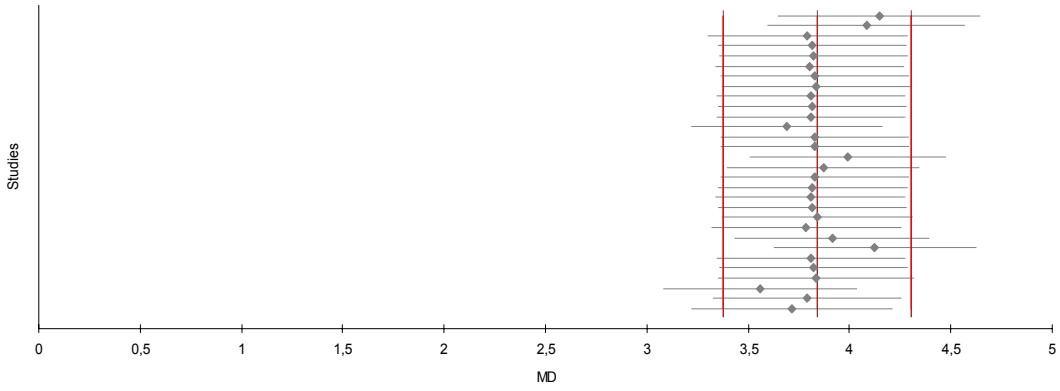


Figure 2. Effect Sizes and Distribution of Rejection Sensitivity (Exclusion Sensitivity Plot)

Mean difference levels, standard deviation levels and p values of related studies on committed meta-analysis are listed in Table 3. Accordingly only in one data group there is a p value greater than the value of 0.05 (Table 3. Study 8). Ozmen and Kolomuç (2004) measured student achievement with a test which can be evaluated two separate categories as multiple choice and open-ended questions on their study. In related study, two different data findings were listed and it's indicated that there isn't any significant difference between experimental and control groups in those t test findings which is given for multiple-choice questions. It is also seen in Table 3 that there is significant difference in favor of experimental group at the level of 0.05 between experimental and control groups in all the data sets of other studies. Thus, it's understood that data sets which are achieved from related studies can be combined and a common Effect Size can be given.

 

Table 3. Meta-analysis MD, 99% CI and p value findings

| Study ID | Date | Referans | MD | 99% CI | *p* |
|---|---|---|---|---|---|
| Study 1 | 2002 | 1 | 1,83 | 0,5606 to 3,0994 | 0,0002 |
| Study 2 | 2002 | 2 | 1,37 | -0,175 to 2,915 | 0,0224 |
| Study 3 | 2002 | 3 | 4,21 | 2,7966 to 5,6234 | < 0,0001 |
| Study 4 | 2003 | 4 | 7,65 | 1,4433 to 13,8567 | 0,0015 |
| Study 5 | 2003 | 5 | 21,45 | 6,3694 to 36,5306 | 0,0002 |
| Study 6 | 2003 | 6 | 10,74 | 4,3661 to 17,1139 | < 0,0001 |
| Study 7 | 2003 | 7 | 7,48 | -0,6252 to 15,5852 | 0,0174 |
| Study 8 | 2004 | 8 | 4,35 | -2,9522 to 11,6522 | 0,1249 |
| Study 9 | 2004 | 9 | 17,19 | 7,4896 to 26,8904 | < 0,0001 |
| Study 10 | 2005 | 10 | 13,4 | 3,2341 to 23,5659 | 0,0007 |
| Study 11 | 2005 | 11 | 19,96 | 9,3166 to 30,6034 | < 0,0001 |
| Study 12 | 2005 | 12 | 9,761 | 6,8032 to 12,7188 | < 0,0001 |
| Study 13 | 2005 | 13 | 7,48 | -0,5889 to 15,5489 | 0,0169 |
| Study 14 | 2006 | 14 | 9,86 | -1,1361 to 20,8561 | 0,0209 |
| Study 15 | 2006 | 15 | 2,161 | 0,5537 to 3,7683 | 0,0005 |
| Study 16 | 2006 | 1 | 2,8 | 0,0789 to 5,5211 | 0,008 |
| Study 17 | 2006 | 17 | 11,12 | -0,9851 to 23,2251 | 0,018 |
| Study 18 | 2007 | 18 | 11 | 2,2179 to 19,7821 | 0,0013 |
| Study 19 | 2007 | 19 | 19,551 | 9,1514 to 29,9506 | < 0,0001 |
| Study 20 | 2007 | 20 | 20,54 | 8,3349 to 32,7451 | < 0,0001 |
| Study 21 | 2007 | 21 | 3,696 | 0,9325 to 6,4595 | 0,0006 |
| Study 22 | 2007 | 22 | 14,22 | 7,608 to 20,832 | < 0,0001 |
| Study 23 | 2008 | 23 | 2,71 | 0,8667 to 4,5533 | 0,0002 |
| Study 24 | 2008 | 24 | 1,86 | 0,5561 to 3,1639 | 0,0002 |
| Study 25 | 2008 | 25 | 8 | 2,3072 to 13,6928 | 0,0003 |
| Study 26 | 2008 | 26 | 12,29 | 2,3753 to 22,2047 | 0,0014 |
| Study 27 | 2008 | 27 | 3,884 | 2,2492 to 5,5188 | < 0,0001 |
| Study 28 | 2008 | 28 | 8,592 | 6,6248 to 10,5592 | < 0,0001 |
| Study 29 | 2008 | 29 | 13,791 | 7,0915 to 20,4905 | < 0,0001 |
| Study 30 | 2008 | 30 | 4,74 | 3,4077 to 6,0723 | < 0,0001 |

It should be known that if the statistical test for heterojenite shows a low p value, the differences between the findings of studies can not be neglected. Therefore, the possible heterojenite should also be examined visually at the same time while the p value is not very high. It's understood that study findings should be considered as homogeneous in situation of a heterojenite test result at the level of significance $p$=0.0001. Thus, existence of only one single common effect can be defended in the findings of different studies with fixed-effect model. Namely, 30 data sets used in this meta-analysis have common effect in terms of CAI. The p value, Q value, E++ (Meta-analysis outcome) value and other relevant findings are reached from this meta-analysis given Table 4. The data about Q and E++ values are given and commented in Table 2. Here, it's seen that, critical level value $p < 0.0001$ is reached from the meta-analysis of 30 data sets. This critical level value reveals that experimental studies which are made for CAI and traditional teaching are supported. The obtained critical p value set to thinking that CAI studies both can be combined and can be considered to be preferred.

Table 4. Evidence Dissemination (meta-analysis)

| Meta-analysis | |
|---|---|
| **General** | |
| Number of studies | 30 |
| Number of participants | 2021 |
| **MD (IV) - Fixed effect model** | |
| Meta-analysis outcome | 3,8383 |
| 99% CI lower limit | 3,3745 |
| 99% CI upper limit | 4,302 |
| z | 21,3186 |
| p-value (two-tailed) | < 0,0001 |
| **Heterogeneity** | |
| Q | 259,8178 |
| p-value (two-tailed) | < 0,0001 |
| H | 2,9932 |
| 99% CI lower limit | 2,4871 |
| 99% CI upper limit | 3,6023 |
| I^2 | 88,84% |
| 99% CI lower limit | 83,83% |
| 99% CI upper limit | 92,29% |
| t^2 | 8,2327 |

| Evidence dissemination bias | |
|---|---|
| **General** | |
| Current outcome measure | MD |
| Current weighting method | IV |
| Current model | Fixed effect |
| Original meta-analysis outcome | 3,8383 |
| 99% CI lower limit | 3,3745 |
| 99% CI upper limit | 4,302 |
| **Effect assessment** | |
| Rank correlation tau-b (continuity corrected) | #SAYI! |
| Ties | 33,349398 |
| P-Q (se) | 177 (56,0506) |
| z | #SAYI! |
| p-value (two-tailed) | #SAYI! |
| Regression method | Egger |
| Regressor weighting | None |
| Intercept | 3,3487 |
| 99% CI lower limit | 1,6785 |
| 99% CI upper limit | 5,0189 |
| p-value (two-tailed) | < 0,0001 |
| **Sensitivity analysis** | |
| Fail-safe N | 2546 |
| Tolerance level | 160 |
| Trim-and-fill method (automatic) | L0 |
| Number of imputed studies | 13 |
| Resulting meta-analysis outcome | 3,4778 |
| 99% CI lower limit | 3,0217 |
| 99% CI upper limit | 3,9339 |

The participant numbers, mean values, standard deviation findings, working areas and numbers of 30 data sets used in this meta-analysis study are listed in Table 5. Accordingly, 10 science, 9 physics, 4 biology, 4 mathematics and 3 chemistry studies which have been carried out with Computer Assisted Instruction in our country in the year 2002-2008 have been included in this meta-analysis research. Moreover, e, c, N, M, SD abbreviations are respectively used instead of experimental group, control group, the number of subjects, mean and standard deviation values in Table 5.

Table 5. The subject numbers of studies, mean and standard deviation findings

| **Subjest area** | | **Study** | **N(e)** | **M(e)** | **SD(e)** | **N(c)** | **M(c)** | **SD(c)** |
|---|---|---|---|---|---|---|---|---|
| Study 1 | Sciences | Sünbül et al. 2002 | 31 | 8,240 | 1,550 | 29 | 6,410 | 2,190 |
| Study 2 | Sciences | Sünbül et al. 2002 | 31 | 8,520 | 2,200 | 29 | 7,150 | 2,430 |
| Study 3 | Sciences | Sünbül et al. 2002 | 31 | 9,070 | 2,170 | 29 | 4,860 | 2,080 |
| Study 4 | Sciences | Çekbaş et al. 2003 | 22 | 70,900 | 7,960 | 20 | 63,250 | 7,650 |
| Study 5 | Sciences | Çekbaş et al. 2003 | 22 | 70,450 | 25,630 | 20 | 49,000 | 9,400 |
| Study 6 | Sciences | Yenice et al. 2003 | 35 | 76,450 | 12,590 | 35 | 65,710 | 7,470 |
| Study 7 | Sciences | Akçay et al. 2003 | 25 | 64,160 | 11,100 | 25 | 56,680 | 11,150 |
| Study 8 | Chemistry | Özmen & Kolomuç 2004 | 40 | 48,580 | 12,400 | 40 | 44,230 | 12,950 |
| Study 9 | Chemistry | Özmen & Kolomuç 2004 | 40 | 42,310 | 17,080 | 40 | 25,120 | 16,600 |
| Study 10 | Physics | Karamustafaoğlu et al. 2005 | 25 | 41,120 | 17,239 | 25 | 27,720 | 9,603 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Study 11 | Physics | Saka & Yılmaz 2005 | 22 | 78,730 | 14,870 | 22 | 58,770 | 12,430 |
| Study 12 | Sciences | Aykanat et al. 2005 | 46 | 28,630 | 4,804 | 46 | 18,869 | 6,130 |
| Study 13 | Sciences | Akçay et al. 2005 | 25 | 64,16 | 11,0 | 25 | 56,68 | 11,15 |
| Study 14 | Biology | Pektaş et al. 2006 | 22 | 57,000 | 12,539 | 21 | 47,140 | 15,252 |
| Study 15 | Physics | Şengel et al. 2006 | 30 | 12,161 | 2,018 | 31 | 10,000 | 2,804 |
| Study 16 | Chemistry | Aydoğdu 2006 | 66 | 18,000 | 6,580 | 62 | 15,200 | 5,340 |
| Study 17 | Biology | Taş et al. 2006 | 26 | 70,810 | 18,370 | 27 | 59,690 | 15,680 |
| Study 18 | Physics | Şen (YL Tezi) 2007 | 8 | 30,120 | 4,010 | 8 | 19,120 | 8,770 |
| Study 19 | Physics | Hançer & Yalçın 2007 | 29 | 168,413 | 16,796 | 29 | 148,862 | 13,806 |
| Study 20 | Maths | Işık 2007 | 37 | 70,810 | 20,490 | 37 | 50,270 | 20,270 |
| Study 21 | Maths | Gökcül (YL Tezi) 2007 | 22 | 17,590 | 3,187 | 19 | 13,894 | 3,619 |
| Study 22 | Maths | Dilek et al. 2007 | 36 | 63,660 | 11,000 | 36 | 49,440 | 10,780 |
| Study 23 | Physics | Kert & Tekdal 2008 | 24 | 16,040 | 1,940 | 24 | 13,330 | 2,920 |
| Study 24 | Biology | Taşçı & Soran 2008 | 29 | 10,200 | 1,650 | 29 | 8,340 | 2,170 |
| Study 25 | Biology | Taşçı & Soran 2008 | 29 | 22,4 | 7,3 | 29 | 14,4 | 9,4 |
| Study 26 | Maths | Birgin et al. 2008 | 22 | 53,000 | 11,180 | 21 | 40,710 | 13,850 |
| Study 27 | Physics | Bozkurt 2008 | 35 | 10,427 | 2,726 | 35 | 6,543 | 2,582 |
| Study 28 | Physics | Bozkurt & Sarıkoç 2008 | 42 | 18,476 | 4,049 | 43 | 9,884 | 2,880 |
| Study 29 | Sciences | Demir & Kabadayı 2008 | 40 | 91,583 | 10,170 | 40 | 77,792 | 12,929 |
| Study 30 | Physics | Kara & Kahraman 2008 | 114 | 15,19 | 4,29 | 139 | 10,45 | 3,84 |

**RESULTS**

The purpose of this study was to obtain a general opinion about effectiveness of taught courses using Computer-Assisted Instruction in Science and Mathematics in our country with meta-analysis method. It has also aimed to investigate whether or not a meaningful difference between Computer Assisted Instruction in Science and Mathematics and traditional teaching.

It has been found that the total Effect Size E++ = 3,8262 and critical significance level $p$ <0.0001 values which were obtained from total 30 data sets of 25 studies used in this meta-analysis research showed the result that Computer Assisted Instruction was pretty much more effective than traditional teaching as academically have been reached. The common views of these studies which formed related data set were also restating the result of Computer Assisted Instruction's effectiveness.

The normal distribution graph of meta-analysis shows that the related data set is adequate and appropriate to calculate the total effect size. Moreover, effect sizes and rejection sensitivity graph gives that result, 30 data set doesn't show fluctuations, deviation and heterogeneous. Thus, the result that related data set is homogenous research figures was found.

The critical $p$ value which is obtained in meta-analysis of related data set gives the result that Computer Assisted Instruction studies can be combined, supported and preferred.

It's seen that there are important contributions of results and suggestions of scientific researches in Science and Mathematics being integrated into the life of the communities on the basis of technological growth. Contributions of technology to educational areas are increasing to use of equipments and providing scientific researches to achieve positive results more quickly. The expectation of these scientific and technological changes reflections in teaching areas to form permanent learning has developed the use technology in education.

The computer-use software in Science and Mathematics, computer use animations, computer use integrated experiment simulations are leading technological applications of performing important and permanent learning. It's seen that computers create statistical differences in experimental works and computers are involved in teaching areas as technological equipment. In that case, computer assisted instruction is a teaching method that

has consisted from self-learning principles. It is used as a platform of learning to strengthen the process of teaching and student motivation. So, students benefit from fast learning process with computer technology.

Computer Assisted Instruction is getting attention of the teachers and its use is increasing continuously in our country. Our training institutions are also enriched rapidly by Ministry of National Education in term of computer hardware. It can be estimated that much more studies involved Computer Assisted Instruction can be enriched to increase valid and reliable literature with interest and equipment richness.

It has been understood that the result of meta-analysis studies were more solid and generalised. The most important result reached with the meta-analysis in this research was that Computer Assisted Instruction has an important level of superiority. The result of meta-analytic superiority achieved from these experimental studies in Turkey in favor of CAI shows compatibility with the results of meta-analysis research made by Bayraktar (2000).

**SUGGESTIONS**

In this meta-analysis research the result of Computer Assisted Instruction is more successful in academic term. However, it is not appropriate to make recommendations about all of the Computer Assisted Instruction because of especially ignoring qualitative research studies. Moreover, the post test findings can not be considered the only indicator of teaching. Thus, it has thought that supporting this meta-analysis in studies including qualitative researches can be useful.

Moreover, it can be thought that much more use of the meta-analysis researches will contribute to science because it is a literature method which can review and combine or compare related individual studies.

CAI can be suggested in situations of all educational institutions since it has been considered to have similar and useful results in these fields.

It can also be thought that quality of education and teaching will increase if educational planners and curriculum developers use Computer Assisted Instruction materials which are consistent with lesson types and contents.

**REFERENCES**

* indicates study included in meta-analysis

Abramson, J. H. (1994). Making Sense of Data. 2nd edition. New York: Oxford University Press.

*Akçay H., Tüysüz, C., & Feyzioğlu, B. (2003). A sample to Effect on Student Attitude and Success of Computer Assisted Science Teaching: Mol Concept and Avogadro Number. The Turkish Online Journal of Educational Technology (TOJET). 2 (2) Article 9.

*Akçay, S., Aydoğdu, M., Yıldırım, H. İ. & Şensoy, Ö. (2005). The Effect of Computer Assisted Instruction in Flowery Plant Subject in 6th Grade Students in Science Education on The Success Of Students. Kastamonu Education Journal. 13 (1) 103-116.

Akgöz, S., Ercan, İ. & Kan, İ. (2004). Meta-Analysis. Uludag University. Faculty of Medical Journal. 30 (2) 107-112.

*Aykanat, F., Doğru, M., & Kalender, S. (2005). Effect on Student Success of Science Teaching with Computer Assisted Map Concepts Method. Kastamonu Education Journal. 13 (2) 391-400.

*Aydoğdu, C. (2006). Effect on Student Achievement of Computer Assisted Chemical Bonding Teaching. Bayburt Faculty of Education Journal. 1 (1) 80-90.

Bayraktar, S. (2000). A Meta Analysis Study on The Effectiveness of Computer Assisted Instruction in Science Education. Unpublished Doctoral Thesis. Ohio University, U.S.

*Birgin, O., Kutluca, T., & Gürbüz, R. (2008). The Effects Of Computer Assisted Instruction on The Students' Achievement in Mathematics at Seventh Grade. 8th International Educational Technologies Conference. Anadolu University Faculty of Education. IETC2008/60. pp346-349. Downloaded from http://ietc2008.home.anadolu.edu.tr/ietc2008/170.doc web address on 12.11.2008.

*Bozkurt, E. (2008). Effect of a Virtual Laboratory Application Prepared in Physics Education Compared to Traditional Laboratory on Student Success: The Rc Circuit Sample in Direct Current. 8th International Educational Technologies Conference. Anadolu University Faculty of Education. IETC2008/60. pp346-349. Downloaded from http://ietc2008.home.anadolu.edu.tr/ietc2008/60.doc web address on 11.11.2008.

*Bozkurt, E. & Sarıkoç, A. (2008). Can The Virtual Laboratory Replace The Traditional Laboratory in Physics Education? Ahmet Keleşoğlu Faculty of Education Journal. (25) 89-100.

Çağatay, P. (1994). Meta-analysis and an application for Health Sciences. Unpublished Master's Thesis. Istanbul University Institute of Health Sciences.

*Çekbaş, Y., Yakar, H., Yıldırım, B. & Savran, A. (2003). Effect on Students of Computer Assisted Instruction. The Turkish Online Journal of Educational Technology (TOJET). 2 (4) Article 11.

*Demir, N. & Kabadayı, A. (2008). Comparison of Traditional and Computer -Assisted Teaching Methods for Preschoolers' Color Concept Acquisition. International Journal of Human Sciences. 5 (1) 1-18.

*Dilek, M., Tarımer, İ. & Sakal, M. (2007). Comparison of The Computer Aided Education Method with Conventional Method In The Training of SPSS Statistical Package Software. Dumlupınar University Academic Information Conference'07. Downloaded from http:// ab.org.tr/ab07/bildiri/48.doc web address on 21.12.2008.

Ergene, T. (1999). Effectiveness of Test Anxiety Reduction Program: A Meta-Analysis Review. Unpublished Doctoral Thesis. Ohio University.

*Gökcül, M. (2007). The Effects of Computer Software Based on Keller's Arcs Motivational Model on The Academic Achievement and Retention at Teaching of Mathematics. Unpublished Master's Thesis. Çukurova University Institute of Social Sciences.

*Hançer, A. H. & Yalçın, N. (2007). The Effects of 'Computer Based Learning Based Upon Constructivist Approach in Science Education' on Attitudes Toward Computers. Kastamonu Education Journal. 15 (2) 549-560.

* Işık, A. (2007). The Effect of Computer Visualization on Students Achievement in Teaching the Limit Concept of Two Variables Functions. Journal of Qafqaz University. (19) 132-141.

*Kara, İ. & Kahraman, Ö. (2008). The Effect of Computer Assisted Instruction on the Achievement of Student on the Instruction of Physics Topic of 7th Grade Science Course at a Primary School. Journal of Applied Sciences. 8 (6) 1067-1072.

Karalar, H. & Sarı, Y. (2007). The Usage of CAI in Instruction of Information Technologies and a Study about Application Results. Dumlupınar University Academic Information Conference'07. Downloaded from http://ab.org.tr/ab07/bildiri/1.pdf web address on 01.11.2008.

*Karamustafaoğlu, O., Aydın, M. & Özmen, H. (2005). Effect on Student Behaviors of Computer Assisted Physics Activities: Simple Harmonic Motion Example. The Turkish Online Journal of Educational Technology (TOJET) 4 (4) 67-81.

*Kert, S. B. & Tekdal, M. (2008). The Effects of Multimedia Based Courseware Prepared on the Basis of Design Principles from Literature on the Academic Achievement and Retention in High School Physics Instruction. Pamukkale University Faculty of Education Journal. (23) 120-131.

* Özmen, H. & Kolomuç, A. (2004). Effect of Computer-Based Teaching on Student Achievement in Solution Concept. Kastamonu Education Journal. 12 (1) 57-68.

*Pektaş, M., Türkmen, L. & Solak, K. (2006). The Effect of Computer Assisted Instruction in The Learning of Urinary System and Digestive System Units for the Science Teacher Candidates. Kastamonu Education Journal. 14 (2) 465-472.

*Saka, A. Z. & Yılmaz, M. (2005). Material Development and Implementation Based on Sheets of Computer Assisted Physics Teaching. The Turkish Online Journal of Educational Technology (TOJET). 4 (3) Article 17.

*Sünbül, A. M., Gündüz, Ş. & Yılmaz, Y. (2002). Effect of 'Computer Assisted Instruction' Prepared According to 'Gagne's Instruction Theory' on Students' Achievement. Selçuk University Faculty of Education Journal. 14, 379-404.

Şahin, M., C. (2005). The Effectiveness of Internet Based Distance Education: A Meta-Analysis. Unpublished Master's Thesis. Çukurova University Institute of Social Sciences.

*Şen, S. (2007). The Effect of Proteus Simulation Software on Students' Achievement in Teaching Electronics at Technical High Schools. Unpublished Master's Thesis, Gazi University Institute of Social Sciences.

*Şengel, E., Özden, M. Y. & Geban, Ö. (2006). Effect on High School Students' Understanding Replace and Speed Concepts of Experiments with Computer Simulation. The 5th National Sciences and Mathematics Training Congress Book. ODTÜ. Ankara. downloaded from http://www.fedu.metu.edu.tr/ufbmek-5/b_kitabi/PDF/Teknoloji/Bildiri/t330.pdf web address on 12.12.2009.

*Taş, E., Köse, S. & Çepni, S. (2006). The Effects of Computer-Assisted Instruction Material on Understanding Photosynthesis Subject. International Journal of Environmental and Science Education. 1 (2) 163–171.

**Taşçı, G. & Soran, H. (2008). The Effects of Multimedia Applications in Cell Division Subject on The Comprehension and Application Levels of Learning Achievement. Hacettepe University Journal of Education. 34, 233-243.

*Yenice, N., Sümer, Ş., Oktaylar, H. C. & Erbil, E. (2003). The Effect of Computer Assisted Teaching on Realizing the Objectives of Science Classes. Hacettepe University Journal of Education. 24, 152-158.

 