

A Meta Analysis on the Effectiveness of Computer-Assisted Instruction: Turkey Sample

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Abstract

Studies focusing on the effectiveness of computer-assisted instruction have been growing recently in Turkey. In this research, quantitative studies comparing the effectiveness of computer-assisted instruction to traditional teaching method and conducted between 1998 and 2007 are studied by meta analysis. Seventy eight studies that have eligible data were combined with meta analytical methods by coding protocol from the 422 master's and doctoral degree and 124 articles. As a result for the study, the effect size of computer-assisted instruction method for academic achievement calculated 1.048. This is large scale according to Thalheimer and Cook, large and Cohen, Welkowitz and Ewen (2000). Recommendations were made based on the results of the study.

Keywords

Computer- Assisted Instruction, Computer- Based Education, Meta-analysis, Effectiveness, Effect Size

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The effectiveness of CAI as compared to traditional instruction has been investigated for decades. Various studies have been conducted at different educational levels and in various areas of instruction (Demirer, 2006; Gençtürk, 2003; Katircioğlu and Kazancı, 2003; Tutaysalgır, 2006; Zhou, Brouwer, Nocente and Martin, 2005). Numerous studies have investigated the effectiveness of computer-assisted instruction among different samples (Chang, 2002; Hacker and Sova, 1998; Hollingsworth and Hoover, 2001; Jacoby, 2005; Wong, 2001).

Both methods have unique features but either one may be used to provide instruction for a particular learning experience. This raises the question of which is the more effective method for a better learning experience. One way to answer this question would be to compare the two methods by measuring the respective gains in learning. Hence, there have been numerous studies of computerized instruction's effectiveness (Yaakub, 1998).

There is a need for a meta-analytic effect analysis of research carried out in Turkey in order to reveal the effectiveness of computer-assisted instruction from a broader point of view. Therefore, the aim of this paper is to bring the bigger picture to light by calculating the effect size of academic success in lessons where computer assisted instruction is used. In order to analyze the impact of computer-assisted instruction 78 research studies were identified. The research question that guided the analysis was 'Does computer-assisted instruction have a positive impact on learners' academic success when compared to traditional teaching method?'

Methods

Meta-analytic effect analysis was used in order to calculate the effect size of computer-assisted instruction on academic success. Meta-analysis can be defined as an analysis of previous analyses and is a statistical method used to combine the results of similar studies (Lyons, n.d; Ergene, 2003).

Data Collection

For meta-analysis, master's theses, doctoral dissertations, published articles, electronic catalogues of university libraries, and symposi-

um proceedings were used as sources of data. Initially, Turkish and English keywords were used to search online thesis centre of 'The Council of Higher Education National Thesis Center.' The search using keywords such as '*bilgisayar destekli eğitim*', '*bilgisayar destekli öğretim*', '*bilgisayar destekli öğrenme*', '*computer based learning*', '*computer- assisted teaching*', '*computer- based training*' revealed a total of 378 studies composed of 155 master's theses and 63 doctoral dissertations. As a result, the sample for the research was finalized and 34 studies on the effectiveness of computer- assisted instruction were included in meta-analysis.

Inclusion Criteria

The following criteria were used for the selection of studies to be included in the current research (Şahin, 2005, 33):

Criterion 1: Time interval of the studies to be included in meta-analysis.

Studies must be conducted in the last decade (1998-2007).

Criterion 2: Published and unpublished resources. Master's theses and doctoral dissertations, periodical academic journals, electronic academic journals, databases, proceedings of conferences and symposia.

Criterion 3: Appropriateness of the research design used in the studies.

Criterion 4: The use of instructional method that fits the research aim.

Criterion 5: To have sufficient numerical data.

Only studies that provide the following values for the groups were included the meta-analysis: sample size, mean and standard deviation.

Coding Method

After the studies that meet the inclusion criteria are identified, a coding method is required to be used for the comparisons to be conducted in the next stage. The coding method should be general enough to allow inclusion of all studies and at the same time specific enough to allow differentiation (Özcan, 2008). The coding method for the

current study was composed of three main sections and a total of 12 questions. The first section was called '*study identity*'. This section had 7 questions. In order to define the study identity, information such as the number of study, the name of study, author names, the year and place of study and publisher name were specified. The second section was called '*study contents*' and had 4 questions (Özcan, 2008). Information regarding the name of the lesson and year of school where computer- assisted instruction was used, the length of instruction, criteria for the selection of participants and the details of the computer- assisted instruction being used was gathered. The third and last section was '*study data*'. Descriptive statistical data such as sample size, mean values and standard deviation values of the experimental and control groups were specified in this section.

Study Characteristics

The study characteristics are the independent variables of the meta-analysis (Tarım, 2003). The study characteristics for the current study were identified as follows: education levels of the participants, lessons in which the studies were conducted, places where the studies were conducted, sample volumes of the studies, standard deviation of the samples in the studies, mean values of the samples in the studies.

Data Analysis

The current study uses '*study effect*' meta-analysis for the analysis of the data. This method is used for group differences when the arithmetical mean values of the dependent variables of each study included in meta-analysis were not obtained using the same scale (Lipsey and Wilson, 2001; Cohen, 1988 cited in Özcan, 2008). The aim of this method is to calculate the difference between the mean values of the control and experimental groups in experimental studies represented by the formula $d = (X_e - X_c) / SD$ (Hunter and Schmidt, 1990). The "d" value obtained represents the effect size and forms the basis for meta-analysis. On the other hand, in order to carry out the calculations for meta-analysis, CMA statistics package was used as the basis, as well as NCSS and Microsoft Excel 2003 programs.

Results

Considering the 78 studies which provide information on the sample size, the experimental group consisted of 2536 and the control group consisted of 2560 students. The studies that involve the highest amount of data were conducted in the year 2006, in Ankara, at the second stage of the primary school and in science lessons.

The results of the meta-analysis conducted based on fixed effects model indicates that academic success was higher in computer-assisted instruction than in traditional teaching method; the standard deviation was 0.03; upper limit of 95% confidence interval was 1.01 and lower limit was 0.89 and the mean effect size (Point estimate) was $ES=0.95$. The mean effect size calculated as 0.95 was accepted to be large in the classifications of both Thalheimer and Cook (n.d.) and Cohen et. al. (2000). Z test calculations revealed statistically significant at .01 level ($z=31.81$; $p<0.01$).

At the end of the homogeneity test, Q statistical value was calculated to be 424.95. As found on the X^2 table, 77 degrees of freedom at 95% significance level was 90.53. Q statistical value of 424.95 was found to exceed the critical value of chi-square distribution at 77 degrees of freedom ($X^2_{0.95}=90.53$). These values indicated that the distribution of the effect sizes of the studies were heterogeneous in terms of fixed effects model. The studies being heterogeneous as indicated by the Q statistical value means that effect size variance is bigger than the variance that could be expected as a result of sampling error (Özcan, 2008). It also means that it is not possible to argue the assumption of fixed effects model, i.e. there being a single real effect that can be anticipated by the findings of the studies. As a result, through analyses based on random effects model, illusions caused by the heterogeneous sample can be eliminated (Yıldız, 2002; Demirel, 2005). Following this, the effectiveness of traditional teaching method and computer-assisted instruction were compared using random effects model.

The results of the analyses conducted according to random effects model indicate that computer-assisted instruction is more effective than the traditional teaching method in terms of academic success with a standard deviation of 0.07; an upper limit of 1.19 and a lower limit of 0.91 for 95% confidence interval and a mean effect size of $ES=1.05$. The effect size value obtained ($d=1.05$) is conside-

red to have a huge effect in terms of the classification by Thalheimer and Cook (n.d.), and a large effect in terms of the classification by Cohen et. al. (2000). Z test calculations revealed statistically significant at .01 level ($z= 14.56$; $p<0.01$).

Discussion

In this study, the mean effect sizes of the 78 studies that were included in meta-analysis in terms of the two effects models used for statistical analysis. The effect of computer- assisted instruction on academic success had a value of 0.95 in terms of fixed effects model which meant that academic success was higher in computer- assisted instruction. Similarly, in terms of random effects model academic success was again higher in computer- assisted instruction with a value of 1.05. This value indicated a large, positive and significant effect size according to Cohen et. al. (2000).

The results of the meta-analysis suggested that computer- assisted instruction led to greater academic success than traditional teaching method. This finding is consistent with the results of other national and international studies (e.g., Akçay, Feyzioglu, and Tüysüz, 2003; Çekbaş, Yakar, Yıldırım and Savran, 2003; Demirer, 2006; Gençtürk, 2003; Katircioğlu and Kazancı, 2003; Köse, Ayas and Taş, 2003; Sagner, Pheleps and Fienhold, 2000; Tezcan and Yılmaz, 2003; Tosun, 2006; Tutaysalgır, 2006; White and Bodner, 2001; Wong, 2001; Zhou, Wytze and Brouwer, 2005). Current findings are also consistent with the results of the meta-analysis study on the effectiveness of computer- assisted instruction conducted by the researchers (Bangert-Drowns, 1985; Hasselbring, 1984; Kulik, 1983; Kulik and Kulik, 1985).

Kulik (1983) observed that at least a dozen meta-analyses on CAI effectiveness have been performed. He reviewed these and discovered the following points: Students like their classes more when taught through CAI. CAI students learn in less time as compared to students taught in the traditional way. Consequently, students learn more in CAI classes as compared to traditional instruction (Yaakub, 1998).

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