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# The Role of Computer-Aided Instruction in Science Courses and the Relevant Misconceptions of Pre-service Teachers

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**Abstract**
This research aims to investigate the ways in which pre-service physics teachers interact with computers, which, as an indispensable means of today's technology, are of major value in education and training, and to identify any misconceptions said teachers may have about computer-aided instruction. As part of the study, computer-based physics course packages were designed by the researchers and computer-aided assignments were prepared by the pre-service physics teachers. At the end of the study, Physics Achievement Tests were administered to the sample pre-service teachers. The research study group included 50 pre-service physics teachers who were taking classes under the Physics Education Department of Kazım Karabekir Faculty of Education at Atatürk University during the 2015-2016 Fall semester. The research data were analysed using SPSS software packages. The study concluded that the computer-aided science courses were effective, and that pre-service physics teachers had misconceptions about computer-aided instruction.
**Keywords:** computer-aided instruction, science education, pre-service teacher

## 1. Introduction

Effective learning depends on the quality of teaching. The failure to adapt learned subjects to new circumstances is an indication that learning has not been completed. Research on the qualifications of learning has contributed to the development of various theories. In particular, familiarity with the building blocks underlying science subjects, such as concept, generalization, principle, phenomenon, theory, law, and natural law, is essential for qualified learning. Due to the nature of the subjects in the sub-disciplines of sciences, it is inevitable that more research will be conducted on factors that affect learning and teaching in this field. As of late, studies focusing on appropriate behavioural features and their role in maximizing interaction in the learning environment have become major points of interest in Turkey. The behaviours which need to be adopted to satisfy the demands of science are continually changing and getting more complicated in parallel with the advances made in technology. The activities, however, capable of being implemented for learning remain limited. For instance, the failure to provide what are seen as rather essential, but nonetheless expensive tools is considered one of the primary factors affecting learning (Yiğit, 2001). Computers, as recent studies have shown, are important in terms of eliminating this particular limitation. In the examination of science content studies, many computer-aided software programs were encountered. However, the present research has found that these ready-made course software programs have come under a lot of criticism in terms of the learning-teaching process (Karapınar, Özdener and Altın, 2001). Figure 1 presents the elements of communication and their correlation, along with their most general features, in a course conducted applying the traditional methods.

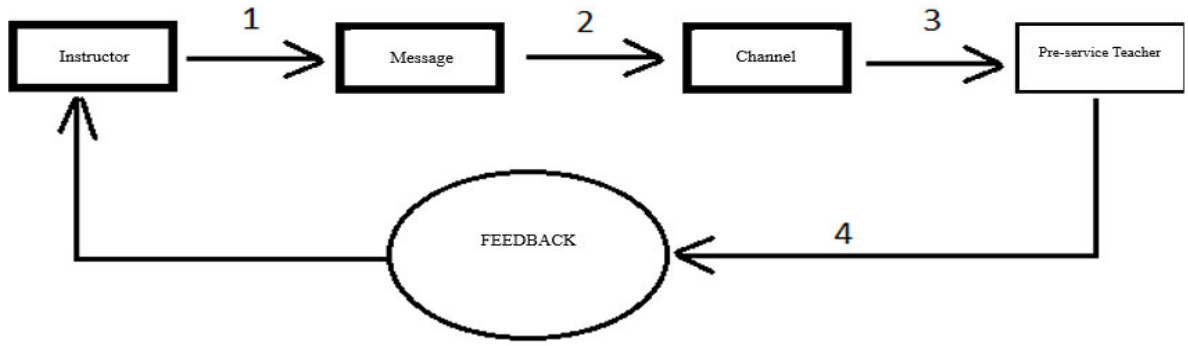


Figure 1. Course application with traditional methods

According to Figure 1; 1) The instructor creates a message by encoding the behavior with a number of distinctive symbols. 2) The messages are transmitted to the pre-service teacher through various tools and methods, here referred to as channel. 3) The pre-service teacher receives the stimuli for the encoded behavior by means of “decoding” process. 4) The pre-service teacher interprets the incoming information and gives feedback (Gordon, 2000).

Today, we have knowledge at our fingertips thanks to electronic instruments. The most popular

information technology in education is computers. The utilization of computers in all learning and teaching activities is called "Computer-Aided Instruction (CAI)" (Aykanat and Kalender, 2005).

In the early 21st century, educational technologies, such as the tools and materials developed to captivate several sense organs and thereby improve the quality of education provided by schools, have been widely employed. Although the date of their first use goes back many years, the use of computers in education has boomed as of late. The most recent studies show that computers can be used by children starting from three years of age, provided that appropriate methods are employed (Gürdal, Şahin and Çağlar, 2001).

In the field of education, a computer can be variously defined as a teaching machine, a deputy teacher or an audio-visual device. Experimental programs and practices have aimed to ensure reinforcement of the subjects, and in addition to helping to improve advanced synthesis, analysis and problem solving abilities, they serve to facilitate low-level researching skills, a prerequisite for enhancing advanced abilities (Gürdal, Şahin and Çağlar, 2001). The recently increased use of web services and computers has aimed to improve the teaching process and learning achievements. Today, computer-aided instruction includes simultaneous and non-simultaneous cooperation (Jürgen and Gunnar, 1999).

### *1.1. Objective*

This research aims to investigate the ways in which pre-service physics teachers interact with computers, which, as an indispensable means of today's technology, are of major value in education and training, and to identify any misconceptions said teachers may have about CAI.

### *1.2. Limitations*

The sample of the study was limited to 50 pre-service physics teachers receiving education under the Physics Education Department of the Kazım Karabekir Faculty of Education at Atatürk University.

The research data was limited to evaluations of package programs created for four randomly selected subjects (Vectors, Two-Dimensional Motion, Laws of Motion and Kinetics Energy) included in the Basic Physics I course and on the CAI assignments prepared by the study sample teachers.

## 2. Method

### *2.1 Research design*

According to Brickhouse (1992) and Gess-Newsome and Lederman (1990), it is challenging, in terms of economy and time, to conduct comprehensive research on the sciences. Research data in these types of studies are generally collected using qualitative and quantitative methods (Brickhouse and Bodner, 1992). The literature includes considerable information about this issue. Researchers such as Cohen and Manion (1990) and Merriam (1988) argue that the findings derived from qualitative and quantitative methods will be more reliable. This combination of methods is commonly used worldwide and is recommended to be appropriate for researchers who conduct studies on their own or in small groups. According to Ayas (1993) and Akdeniz (1993), future research to be conducted using this combination of methods will provide educational instructors with useful information.

### *2.2 Study group and data collection tools*

The pre-service teachers who had participated in the Special Methods in Physics Education II course, a prerequisite for pre-service teachers in the physics education department during the 9th term, were divided into two groups, with one of the groups serving as the control group and the other as the experimental group. Pre-tests were administered to the groups prior to conducting the study. The experimental group alone was administered the CAI, while the control group maintained their normal course of traditional method instruction. At the end of the study, both groups were administered post-tests. All of the experimental group pre-service teachers were given assignments that were to be prepared in digital environments. The evaluation of these assignments was based on face-to-face interviews conducted with the pre-service teachers who had prepared them. During the evaluation, conclusions were drawn from the questions posed to the pre-service teachers, and various recommendations were then made.

### *2.3 Data analysis*

The independent samples t-test was conducted to determine whether a statistically significant difference was present between the pre-tests and the post-tests. The research data were analyzed using a significance level of 0.05, and statistical analysis of the data was conducted with the SPSS 20 software package.

## 3. Findings

Table 1 includes the descriptive statistics and independent samples t-test results of the scores obtained from the experimental and control group pre-service teachers on the pre-tests and the post-tests.

 

Table 1.The descriptive statistics and independent samples t-test results of the scores from the experimental and control group pre-service teachers on the pre-tests and the post-tests.

| Test | Group | N | Mean | Std. Deviation | t | df | P |
|---|---|---|---|---|---|---|---|
| Pre-test | Control | 25 | 49.00 | 7.64 | -1.880 | 48 | 0.066 |
| | Experimental | 25 | 53.20 | 8.15 | | | |
| Post-test | Control | 25 | 70.00 | 7.22 | | | |
| | Experimental | 25 | 83.20 | 4.54 | -7.742 | 48 | 0.000 |

According to Table 1, the mean of the scores obtained from the control group pre-service teachers on the pre-tests was 49, while the mean of the scores of the experimental group pre-service teachers on the pre-tests was 53.2. The control group had a standard deviation of 7.64 and the experimental group, a standard deviation of 8.15. Results from the descriptive statistics and independent samples t-test analysis comparing the pre-tests scores of the control group and the experimental group were found to be $p>0.05$. Post-test mean scores of the control group pre-service teachers and the experimental group pre-service teachers were 70 and 83.2, respectively. The control group had a standard deviation of 7.22 and the experimental group, a standard deviation of 8.15. Results from the descriptive statistics and independent samples t-test analysis comparing the post-test scores of the control group and the experimental group were found to be $p<0.05$.

Figure 2 below presents the means of the scores obtained from the control and experimental groups on the pre-tests and post-tests, as well as the improvements that resulted between these two tests (Figure 2).

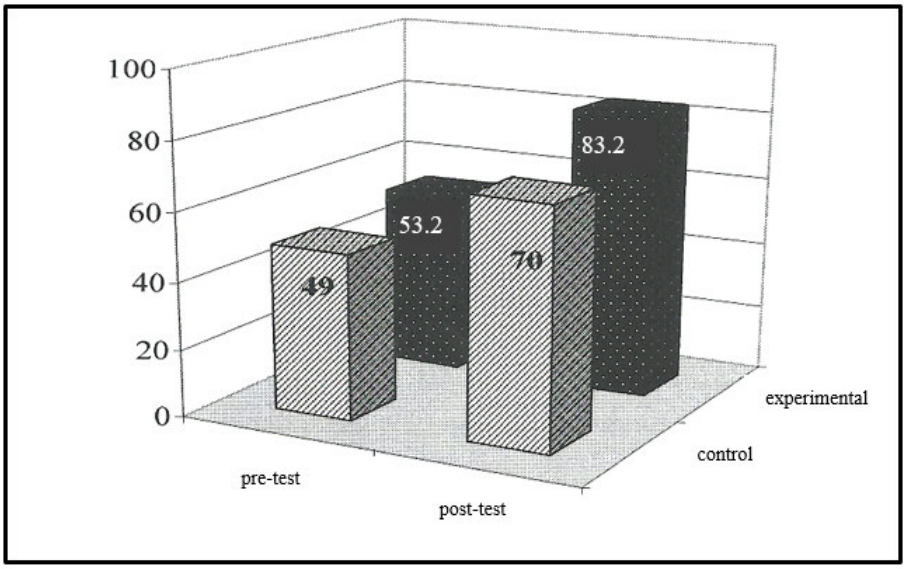


Figure 2. Visual presentation of the scores obtained by the experimental and control group pre-service teachers on the pre-tests and post-tests.

The following presents excerpts from the individual interviews conducted with pre-service teachers. These excerpts were considered to be of particular importance regarding the assignments prepared by the pre-service teachers at the end of the study.

A portion of the interview conducted with pre-service teacher labelled S1:

Researcher: What is the most distinctive feature your study should have in order to achieve better results than those obtained from classical narration and to draw the attention of the students?

*Pre-service teacher: Remarkable points should be emphasized.*

Researcher: From your point of view, how important is it for these remarkable points to be directly associated with the subject?

*Pre-service teacher: Not very important! Being a remarkable point is all that matters.*

A portion of the interview conducted with pre-service teacher labelled S2:

Researcher: When you begin teaching courses with the package you prepared, how would you rank yourself in terms of the priority of your role in the classroom?

*Pre-service teacher: Because I have already transferred to a digital platform all the things to be explained and illustrated, my function in the classroom is no longer important. Therefore, I wouldn't rank myself near the top, in terms of priority.*

## 4. Conclusion and Recommendations

Computer-aided instruction has a minimum of three dimensions, with the first one being teachers who serve as supervisors and controllers in learning-teaching activities. The second is the computer equipment designed to

 

support the learning experience (Merill, 1992). Finally, the third are the instructional software programs used to facilitate interaction between students and computers. These complementary dimensions should be carefully handled in the planning of the learning-teaching activities (Bülbül, 2000).

To summarize the findings of the study, Table 1 shows that the means of the scores obtained by the control and experimental group pre-service teachers on the post-tests were 49 and 53.2, respectively. The descriptive statistics and independent samples t-test results revealed no statistically significant difference between the groups at the beginning of the study. Furthermore, low standard deviations of the group scores in the pre-tests indicated similar preliminary information of the individuals constituting the groups.

Again, returning to Table 1, the means of the scores obtained from the control and experimental group pre-service teachers on the post-tests were 70 and 83.2, respectively. T-test results indicated there to be a statistically significant difference between the post-test scores, a finding which suggests CAI approaches to be far better than classical teaching methods.

Meaningful conclusions can be drawn from other significant results obtained from the study. For instance, any course teaching style which happens to be individually agreeable does not necessarily make the entire method successful. Therefore, the individuals who utilize the relevant method should precisely understand the pros and cons of it. In the CAI method, it was observed that the pre-service teachers perceived this approach to be shaped according to their own misconceptions as opposed to what the approach required. These misconceptions can be listed as follows:

a) Preparation of the CAI materials with an overall focus on the subjects
b) Disregard for whether or not the remarkable points are related to the subjects
c) Assumption that computers serve directly as teachers
d) Failure to notice divergence from the student-oriented education
e) Confining to the background the fact that the actual function of CAI is to facilitate teaching or perceiving this function in this way
f) Failure to understand that actions viewed as difficult or impossible to perform at the moment should be carried out through CAI as a way to simplify their work.

The recommended actions to be taken can be summarized as:

1- Emphasis of the fact that a computer is a means rather than end
2- Implementation of the necessary measures to enable students to become computer literate in this respect
3- Prevention of the existing and emerging misconceptions within the schools through the provision of in-service seminars
4- Frequent review of computer course curriculum programs in accordance with the rapidly changing and developing technologies and the maintenance of these programs at such a level so as to satisfy the needs of the students, with a view to getting the most out of the actual functions of the computers.

**References**

Akdeniz, A. R., (1993). The implementation of a new secondary physics curriculum in Turkey: An exploration of teaching activities. Unpublished doctoral dissertation, University of Southampton, England.

Alkan, C., (1986). Education Technology. Yargıçoğlu Publishing: Ankara.

Altın, K., (2001). Computer use in physics classes: Developing the lesson that a simulation software, (p.242-247). İstanbul: Education symposium proceedings book of science in Turkey at the beginning of the new millennium.

Ayas, A. (1993). A study of teachers' and students' view of the upper secondary curriculum and students' understanding of introductory chemistry concepts in the East Black-Sea region of Turkey. Unpublished doctoral dissertation, University of Southampton, England.

Aykanat, F., Doğru, M. & Kalender, S., (2005) Students effect on the success of the Concept Mapping Method with Computer Aided Teaching Science. Kastamonu Education Journal, 13, 2.

Brickhouse, N. W., & Bodner, G. M. (1992). The beginning science teacher: Classroom narratives of convictions and constraints. Journal of Research in Science Teaching, 29, 471–485.

Bülbül, H. İ. (1999). Screen design software for training purposes. Journal of National Education, 141.

Cohen, L. & Manion, L. (1990). Research Methods in Education. Third Edition, Routledge, London.

Çilenti,K. (1985). Science and technology education. Ankara: Kadıoğlu Publishing.

Gess - Newsome, J., & Lederman, N. G. (1990). The preservice microteaching course and science teachers' instructional decisions: A qualitative analysis. Journal of Research in Science Teaching, 27(8), 717-726.

Gordon, T. (1993). Effective teacher training. (E. Aksay & B. Özkan, Trans.). İstanbul: Ya-Pa Publication.

Guzdial, M., Kolodner, J., Hmelo, C., Narayanan, H., Carlson, D., Rappin, N., Hbscher, R., Turns, J. & Newstetter, W.(1996). Computer Support for Learning through Complex Problem Solving.

 

Communications of the ACM 39(4), pp.43-45.

Gürdal ,A., Şahin, F. & Çağlar. A. (2001). Science Education (Principles, Strategies and Methods). İstanbul: Marmara Üniversitesi Publishing.

Koch, J. H., & Teege, G. (1999). Problem Based Learning in Computer Science. In Proc. of 2nd International Conference on New Learning Technologies. Bern, Switzerland. see http://citeseer. nj. nec. com/369966. html.

Karapınar, F. Özdener, N. Salan, Ü. (2001) Designed to be examined in terms of widely used software in the secondary physics and chemistry. Ankara: Journal of National Education Publishing

M.E.B.(1991). Computer Aided Education in Turkey, Ankara: Print House of Course Tools Center.

Merriam, S. B. (1988) Case study research in education (San Francisco, CA, Jossey-Bass).

Özdener,M. ve Erdoğan, B. (2001). Computer-aided design simulation and training applications development, (ss.235-241). İstanbul: Education symposium proceedings book of science in Turkey at the beginning of the new millennium.

Pelgrum, W. & Plump, T.(1991). The Use of Computer in Education Worldwide, Pergemon Pres Inc, 1991, s. 125.

Şeniş, F.(1991). Standard Problems in Computer Aided Instruction Software, Educational Technology and Computer Aided Instruction Book 1 Symposium., 25-27 of September. Anadolu University. s.183-191.

Yiğit, N. (2001). Teacher-centered approach to program development in physics education. Unpublished doctoral dissertation, Karadeniz Technique University, Turkey.