

THE EFFECTS OF INTERACTIVE EXERCISES ON STUDENTS' ACHIEVEMENT: Using the Open Source Authoring Application

**Omür AKDEMİR
Kürsat KUNT
Inan TEKİN
Bülent Ecevit University,
Zonguldak 67300, TURKEY**

ABSTRACT

Freeware open source authoring tools are available and easily attainable over the internet for teachers to develop their own interactive instruction. This study investigated the effects of interactive exercises developed using the open source authoring tool on students' achievement using the pre-test post-test with the control group research design with 35 seventh grade students in the Science and Technology course.

Findings showed that the use of interactive exercises embedded in the instruction improves the achievement of students more than the instruction having traditional exercises. Further research should compare the effects of interactive exercises completed individually to the effects of interactive exercises completed in a group format to present the effects of the individual and the group work.

Keywords: Interactive exercises, authoring applications, instructional design, computer-based learning, science education.

INTRODUCTION

The amount of information produced has been going beyond the boundaries of human mind and becoming hard to keep up with. In the same way, technology develops at an enormous speed with the developments that shape our life. Each day new technologies are invented and enter our life. High science and technology level contribute the economic, social and cultural development. The development in science and technology gains ground at an enormous speed.

In today's world where information increases accumulatively, it has been crucial that people should be educated as the ones doing investigations and questioning, producing information and knowing how to attain it, not as the ones being passive learners. Science and Technology course comes first to make students have such abilities (Tatar & Kuru, 2006). Investments are heavily made in schools to increase the number of computers and networking of classrooms in order to raise students capable of questioning (Pelgrum, 2001). The Science and Technology course is an interdisciplinary course utilizing information from physics, chemistry and biology. Due to the complex nature of the course, there are many abstract concepts in the Science and Technology course that makes it difficult to understand (Ozsevec, 2006). The use of visual materials to teach abstract concepts is recommended (Yalın, 2007). The usage of visual materials in teaching of abstract concepts facilitates the recall of information. Karamustafaoğlu (2006) emphasizes that material usage plays an important role especially in Science and Technology programs' achievement. Technology has been widely used in education. The presence of technology in education system made learning and teaching activities easier (Isman, 2005).

Another effect of technology in education is that it assists students to have positive tendency towards lessons during learning process. Van Berkum & De Jong (1991) emphasize that computer simulations have many advantages over the traditional instructional means such as textbooks allowing students systematically comprehend theoretical concepts. Also Van Berkum & De Jong (1991) stress that computer simulations permit students interact with the instruction by changing the parameters to either solve problems or practice tasks in a realistic environment easily. Learning environments empowered with technology arouse interest among students and raise learning motivation. Students learn willingly in classes equipped with technology. Jimoyiannis and Komis's study (2001) in which researchers compared a group of students receiving traditional classroom instruction with a group of students exposing to both traditional instruction accompanied with computer simulations.

The effects of these two applications on students' understanding of velocity and acceleration were investigated. Results of the study revealed that students using computer simulation compared to students learning with traditional instruction achieved significantly higher results on the research tasks. As a result, researchers reached the conclusion on computer simulations that computer simulations can be a useful complement or additional lesson resource in order to enable students to understand velocity and acceleration subjects much easier.

Güven and Sülün (2012), also compared a group of eight-grade students who received traditional classroom instruction and a computer assisted instruction in science class. Before the study, researchers administrated the Science and Technology Achievement Test to measure the students' achievement and the Science and Technology Attitude Scale to measure students' attitude.

The computer assisted instruction called "Vitamin" about the science subject of "Structures and Features of Matter" was used in the study.

Besides Vitamin, researchers enriched the lesson content by preparing slide shows, animations, puzzles, interactive tests and short videos for experiments. Researchers found that computer assisted instruction has more positive effects on students achievement in science lesson as teachers are able to teach some abstract subjects. Chang, Chen, Lin, and Sung (2008) conducted two experiments in their study. In the first experiment the differences between simulation-based learning and traditional laboratory learning were investigated in the context of physics studies. Results revealed that simulation-based learning environments that provide learning support are more beneficial than traditional laboratory learning.

In the second experiment, it was investigated that whether students with different abstract reasoning abilities would be influenced with different learning models. Findings showed that different learning models do not have different influence on students with different abstract reasoning abilities. On the other hand, students with higher abstract reasoning abilities appeared to benefit more from simulation-based learning.

It was concluded that making students able to formulate theories and hypotheses is a fruitful way of aiding simulation –based learning. However authoring applications provide user friendly environment for teachers to develop their own interactive instruction. Yet their high license fee prohibits teachers from obtaining them.

Nowadays, freeware open source authoring tools are available and easily attainable over the internet for teachers to develop their own interactive instruction. However there is a limited study on the effects of interactive exercises developed using open source authoring tools on students' achievement in the science and technology course.

This study is designed to address the following research question: Does the use of interactive exercises embedded in the instruction improve the achievement of students more than the instruction having traditional exercises? Reduced cost, increased speed and diversity of programs used in computers are important reasons for computers to become common as part of the instructional process inside the classroom. Pektaş, et al, (2009), carried out another study.

"The Sound and the Light" subject was taught to the experiment group by computer assisted teaching method and by traditional method to the control group. Groups were consisted of 78 fifth grade students. There were 39 students in both experiment and control group

In the study, "The Sound and the Light" achievement test was administered to the both groups as a pre-test and as a post-test. Providing visual instruction to students has the potential to improve students' interest and motivation. Besides visuals, being able to interact with the instruction through exercises enforce students to actively participate class activities. Interactive exercises utilized in the classroom can be used effectively in teaching abstract concepts. However, most of the time teachers cannot develop their own interactive instructional materials due to the lack of knowledge and expertise in computer programming.

METHOD

Context

The study was conducted at the private educational institute preparing primary school students for the nationwide exam that has to be taken by all eight graders in Turkey. Therefore students attending the private educational institute are highly motivated for learning. Socio-economic status of students attending the course is above the average.

Participants

The study group consists of 35 students attending the Science and Technology course organized for the seventh graders. The experimental group has 20 students and the control group has 15 students. The experiment and the control group were assigned randomly from the available two classes in the private educational institute.

Research Design

The quasi-experimental research design with existing groups is used to investigate the effects of interactive exercises developed using the open source authoring tool on students' achievement in the science and technology course. The pre-test post-test with control group research design was used to investigate the research question. The achievement test consisted of sixteen multiple-choice questions with five options was administered to the participants in the control and experimental groups before and after the study.

Experimental Treatment

The course module to teach the subject of "Atom's structure" was designed and developed by researchers using the freely available Open Source authoring application (<http://exelearning.org>) which can be exported in IMS Content Package, SCORM 1.2, or IMS Common Cartridge formats or as simple self-contained web pages.

In this study developed course module was exported as a self-contained web page and saved on the local drive of the computer to be used offline during the four-week application of the course offered in weekends. The course module was designed to include nine events identical to the ones recommended by Robert Gagne. Special emphasize was given to eliciting the performance (practice) while developing the instructional module. Students in the experimental group completed the practice as a whole class activity and the teacher entered the group responses to the computer to receive feedback. Screen views from the developed instructional module's exercise and feedback pages presented at Figure: 1 and Figure: 2.

ATOMUN YAPISI

NELER ÖĞRENECEĞİZ

BİLGİLERİMİZİ HATIRLAYALIM

BAĞLI ATOMLAR

ATOMDAN ÖTE KÖY VAR MI?

İZOTOP ATOMLAR

BİRLİKTE YAPALIM

DOĞRU MU YANLIŞ MI?

BİL BAKALIM

DEĞERLENDİRME

ARAŞTIRMA SORUSU

BİRLİKTE YAPALIM

 **Boşluk Doldurma Soruları**

Aşağıdaki boşluklara uygun kelimeleri yazınız.

1) Bir atomun proton ve elektron sayıları birbirine eşit ise bu atom 'dir.

 2) Atom numarası bir atomun aynı zamanda sayıdır.

 3) Pozitif yüklü iyonlara , negatif yüklü iyonlara ise denir.

Figure: 1
A Screen View from the Exercise Page

ATOMUN YAPISI
NELER ÖĞRENECEĞİZ
BİLGİLERİMİZİ
HATIRLAYALIM
BAĞLI ATOMLAR
ATOMDAN ÖTE KÖY VAR
MI?
İZOTOP ATOMLAR
BİRLİKTE YAPALIM
DOĞRU MU YANLIŞ MI?
BİL BAKALIM
DEĞERLENDİRME
ARAŞTIRMA SORUSU

BİRLİKTE YAPALIM

Boşluk Doldurma Soruları

Aşağıdaki boşluklara uygun kelimeleri yazınız.

1) Bir atomun proton ve elektron sayıları birbirine eşit ise bu atom **bir** **sayı** 'dir.

Your score is 0/2.

2) Atom numarası bir atomun aynı zamanda **proton** sayısıdır.

Your score is 1/1.

3) Pozitif yüklü iyonlara **kation**, negatif yüklü iyonlara ise **elektron** denir.

Your score is 1/2.

Figure: 2
A Screen View from the Feedback Page

Activities of the Control Group

The control group received the instruction in a traditional manner. Participating students used the text-book and completed the exercises on the blackboard. Similar to the experimental group, participants in the control group were also received instruction in a four-week period offered in weekends.

Data Collection Instrument

Students' achievement on the subject of "Atom's structure" was measured through a multiple-choice test. The multiple-choice test had sixteen questions with five options for each question. The measure of internal consistency of the multiple choice test was found as 0.671. Twenty minutes were given students to complete the achievement test before and after the study.

Data Analysis

Students received one point for each of their correct answer in the pre-test and post-test. Scores of the students ranged from 0 to 16 in the multiple-choice test. In order to answer research questions, descriptive statistics, Shapiro-Wilk test, independent t-test and the Mann Whitney U test were used for the data analysis.

RESULTS

The descriptive analyses of pre-test and post-test results of participants are presented in the Table: 1.

Table: 1

The Descriptive Analysis of the Pre-test and the Post-test Results of Participants

		N	Mean	Std. Deviation
Pre-test	Experimental Group	2	8.2	2.67
	Control Group	1	6.6	2.25
	Experimental Group	5	6	
	Control Group	5	6	
Post-test	Experimental Group	2	15.	0.73
	Control Group	1	12.	1.98
	Experimental Group	5	26	
	Control Group	5	26	

Before testing the hypothesis, the tests of normality were conducted to determine which types of test were going to be used for analysis. The results of the Shapiro-Wilk test (see Table-2) revealed that only the post-test scores of the experimental group are not normally distributed. Therefore non-parametric test was used for hypothesis testing when the post-test scores of the experimental group are analyzed.

Table: 2

The Results of the Shapiro-Wilk test

	Shapiro-Wilk		
	Statistic	Df	Sig.
Ex_pretest	.885	15	.056
Ex_posttest	.783	15	.002
Cont_pretest	.964	15	.756
Cont_posttest	.937	15	.342

* This is a lower bound of the true significance.
a Lilliefors Significance Correction

Initially students' prior knowledge was compared in the experimental and the control group. The result of the independent t-test revealed that there was not any significant difference between the pre-test scores of the experimental and the control groups ($t(33) = 1.85$; $p > 0.05$) (See Table-3). This finding shows that before the study, participants' knowledge in the control group on the subject of "Atom's structure" is not different from the study participants' knowledge in the experimental group.

Table: 3
Pre-Test Comparison of the Experimental and Control Groups

	Mean Difference	Std. Error Difference	t-test for Equality of Means		t	df	Sig. (2-tailed)
			95% Confidence Interval of the Difference				
			Lower	Upper			
Experimental- Control	1.58	0.855	-0.15	3.32	1.85	33	0.073

In order to investigate whether the use of interactive exercises embedded in the instruction improves the achievement of students more than the instruction having traditional exercises. The post-test scores of students in the experiment and the control groups were compared. The result of the Mann-Whitney U- test revealed that there is a significant difference between the post-test scores of the experimental and the control groups ($U = 18.5$; $p < 0.05$) (See Table-4). This finding indicated that achievement of the students in the experimental group is higher than the achievement of the students in the control group. This result indicates that students using interactive exercises are more successful than students using exercises in the instruction in a traditional manner.

Table: 4
Mann-Whitney U for the Post-test Comparison of the Control and Experimental Groups

Groups	N	Mean Rank	Sum of Ranks	U	p
Experimental	21	24.58	491.5	18.5	0.05
Control	11	9.23	138.5		

DISCUSSION AND CONCLUSION

Findings indicate that the use of interactive exercises embedded in the instruction developed with the open source authoring application improves the achievement of students more than the instruction where traditional exercises are used.

This result supports the promise that improving skills of teachers in the instructional design and development is necessary to improve the quality of the instruction. Veen (1993) states that schools can only provide with information and communication technology (ICT) use , but what really matters is teachers' skills and capabilities of using (ICT) both in learning and teaching. Schwarz, Jason & Ajay (2007) emphasize that integration of interaction through computer modelling tools in courses; teachers can become more knowledgeable consumer of computer technology to foster learning.

Becker (2000) emphasizes that teachers should have a good knowledge of using computers to support traditional skills.

In conclusion, it is recommended that using interactive exercises developed with the open source authoring application improve student learning more than exercises used in traditional format in the Science and Technology course.

Improving the skills of teachers in the instructional design helps to improve the quality of the instruction and learning of the students.

Therefore in order to expand the influence the use of open source authoring applications should be the compulsory part of the instructional technology course in teacher education programs to furnish prospective teachers with such skills.

Wedman, Diggs (2001); Wheeler (2001), also emphasize that determining the future of Computer and Information Technologies largely depends on the training of pre-service teachers.

It is also advisable for the faculties of education to take the responsibility of effective training of prospective teachers to be well qualified with teaching and learning Computer and Information Technologies (Dexter & Riedel 2003).

Further research should compare the effects of interactive exercises completed individually to the effects of interactive exercises completed in a group format to present the effects of the individual and the group work.

Although it is beyond the findings of the study, another recommendation for future research is to investigate how to create the learning environment for teachers to enable them to develop positive approaches related to computer-based learning and equip them with the necessary computer skills and pedagogies.

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BIODATA and CONTACT ADDRESS of AUTHORS



Dr. AKDEMIR received his Ph.D. from the Syracuse University's Instructional Design, Development & Evaluation Department. He works as an Associate Professor and serves as a chair at the Computer Education & Instructional Technology Department of the Bülent Ecevit University's Ereğli Education Faculty.

Associate Professor Omür AKDEMIR Bülent Ecevit University, Ereğli Education Faculty, Computer Education and Instructional Technology Department, 67300 Kdz. Ereğli, Zonguldak, TURKEY
Tel: 0 372 323 38 70,
Fax: 0 372 323 86 93
Email: omurakdemir@gmail.com



Mr. KUNT received his M.Sc. degree from the Graduate Student at the Curriculum and Instruction department of the Bülent Ecevit University. He works as a Science and Technology teacher.

Kürşat KUNT,
Bülent Ecevit University's Graduate School of Social Sciences,
67300 Zonguldak, TURKEY
Email: kursatkunt32@gmail.com



Mr. TEKIN received his M.Sc. degree from the Curriculum and Instruction department of the Bülent Ecevit University and now is pursuing his Ph.D. studies. He works as a lecturer at the Bülent Ecevit University.

Inan TEKIN,
Bülent Ecevit University's Graduate School of Social Sciences,
67300 Zonguldak, TURKEY
Email: inantekin@windowslive.com or kursatkunt32@gmail.com

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