The Effects of Interactive Exercises on Students’ Achievement: Using the Open Source Authoring Application

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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 and in a group format.

Keywords: Interactive exercises; Authoring Applications; Instructional Design; Computer-Based Learning; Science Education

1. 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).

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 (Özsevec, 2006). The use of visual materials to teach abstract concepts is recommended (Yalin, 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 (İsman, 2005). Another effect of technology in education is that it assists students to have positive tendency towards lessons during learning process. Learning environments empowered with technology arouse interest among students and raise learning motivation. Students learn willingly in classes equipped with technology.

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Besides the quality of learning outcomes, using computer technology also saves time in teaching and learning. Computers have become the most common devices for teachers to present information. 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.

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 can not develop their own interactive instructional materials due to the lack of knowledge and expertise in computer programming. 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?

2. Method

2.1. 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. Therefore students attending the private educational institute are highly motivated for learning. Socio-economic status of students attending the course is above the average.

2.2. Participants

The study group consists of 35 students attending the Science and Technology course organized for the seventh graders in 2010. 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.

2.3. 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.

2.4. 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.
2.5. 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.

2.6. 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.

2.7. 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.

3. 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

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental Group</td>
<td>20</td>
<td>8.25</td>
<td>2.67</td>
</tr>
<tr>
<td>Control Group</td>
<td>15</td>
<td>6.66</td>
<td>2.25</td>
</tr>
<tr>
<td>Post-test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental Group</td>
<td>20</td>
<td>15.3</td>
<td>0.73</td>
</tr>
<tr>
<td>Control Group</td>
<td>15</td>
<td>12.26</td>
<td>1.98</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>Statistic</th>
<th>Df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ex_pretest</td>
<td>.885</td>
<td>15</td>
<td>.056</td>
</tr>
<tr>
<td>Ex_posttest</td>
<td>.783</td>
<td>15</td>
<td>.002</td>
</tr>
<tr>
<td>Cont_pretest</td>
<td>.964</td>
<td>15</td>
<td>.756</td>
</tr>
<tr>
<td>Cont_posttest</td>
<td>.937</td>
<td>15</td>
<td>.342</td>
</tr>
</tbody>
</table>

* 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

<table>
<thead>
<tr>
<th></th>
<th>Mean Difference</th>
<th>Std. Error Difference</th>
<th>95% Confidence Interval of the Difference</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental-Control</td>
<td>1.58</td>
<td>0.855</td>
<td>-0.15</td>
<td>3.32</td>
<td>1.85</td>
<td>33</td>
</tr>
</tbody>
</table>

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.

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

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
<th>U</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>20</td>
<td>24.58</td>
<td>491.5</td>
<td>18.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Control</td>
<td>15</td>
<td>9.23</td>
<td>138.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Results 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. 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. 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. 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.

References