The study of application of algebrator software for mathematical problems solving

Zahra kalantarnia\textsuperscript{1*}, Mohsen Rostamy-Malkhalifeh\textsuperscript{1}, Ahmad Shahvarani\textsuperscript{1}, Mohammad-Hassan Behzadi\textsuperscript{1}

(1) Department of Mathematics, Science and Research Branch, Islamic Azad University, Tehran, Iran

**ABSTRACT:**
While computer and pertinent technologies are marching in every corner of the world and people’s life, it is far beyond surprise to find E-learning one of the most important parts of learning and training in education system (especially mathematics). The present work is a try, though quasi-experimental research method and cluster sampling to adopt 44 high school girl students, to gauge effects of using Algebrator on math learning of the students. The results from Leven's test and independent samples cleared it up that the utilization of the software was positively effective on better math learning comparing with traditional methods. Apparently, the software may be used as aid for problem solving during self-study courses.

**KEYWORDS:**
Math learning, algebrator software, learning, information technology, computer.

1. **INTRODUCTION**
It is on safe ground to claim that ever-increasing growth of technology, especially in information and communication field, has affected learning methods in and outside the school frame. Technology paves the path for a lifetime learning course and all may enjoy what they need to know by easy access to information [7]. Therefore, educational technologies in learning and training are changing tradition class frame into a dynamic environment for nurturing creativity, innovation, and facilitating learning [4]. Technology-based knowledge, nowadays, is available in many developed countries. Smart schools are a great step in virtual learning, and online learning and similar methods are new form of learning method of the new century [1]. Mathematics learning is a special case among the other courses, as students’ role is almost a passive role and the instructor dictates the material. Technology enables teachers to control the method adopted for solving the problems. In comparison with many features of software learning, which enable students to inspect and survey every aspects, boards and papers have less chance to stand the trend toward electronic learning. Many scholars, (e.g. Polya and Shoenfeld) named feedback for the instructor and step-by-step evaluation, solving process within a specific framework as some of the features of electronic learning. Computer and software are able to provide real time feedback to the users and lead the process within a specific framework. In addition, they limit the search fields to accelerate problem solving.

* Corresponding author. Email address, Z.kalantarnia@mailfa.org
Software-based learning is confirmed by many approaches, models, and theories. Studies shown when probably mixed with education methods, electronic learning is effective tools to meet the goals of educations. Some results shown that students tend to memorize 20 percents of what they see, 30 percents of what they hear and 50 percents of what they see and hear. When student have the chance to listen, watch, and interact with learning environment, this figure increases to 80% [8]. The advantages of using technology in math learning are numerous and varied. (Fig .1). Electronic technology such as calculators and computers are also recommended by the USA and Canada national association of teachers, as they believe that technology helps learning and training mathematic concepts [2]. This study is focused on using Algebrator for holding math courses. Using this software, students will be able to explore different learning methods.

2. LITERATURE REVIEW
Saeed Safarian and Hamzeh Mirhosseini (2010) shown in an article “Comparison between effects of software-aid education and traditional education system in math learning” that new methods were ineffective for topics “angle and multiply”, and it was found effective for “division”, “subtraction” and “area calculation” [5]. Azam Zakeri (2004) studied in her research “Comparison of effect of software-aid education and traditional education methods on mat learning for 6th grader boys” and found significance relation between experiment and control groups [6]. Khouybaba (2010) “math learning using technology” examined positive role of technology on math learning and used Maple software in their work. The software helped students with imaginations. Moreover, computation application of the software helped the students in practical implementation of equations roots [3]. A general view of the literature shows that utilization of education aid in math training and learning helps acceleration of learning and motivates the students. This study tries to focuses on newly introduced software to the market.
3. HYPOTHESIS
In comparison with traditional methods, Algebrator software positively affects math learning among students.

4. METHODOLOGY
Considering type of the research, the present work is a quasi-experimental method. The reason is that all variables are under control, participants do not represent real human features. This method entails adopting one or more groups as control and experiment groups randomly, while independent variables is implemented in experiment group. Following implementation, surveying post-test factors for all participant groups, and ensuring matched groups, the new training method was employed for experiment groups and traditional method was employed for the control group. Afterward, the tests were implemented for both groups and the results were analyzed.

5. PARTICIPANTS
Statistic society in the present work was consisted of students of five class of 2nd year of high school in mathematics who were compared with 100 students of experimental sciences at the same level. Two classes (44 students) were adopted through cluster sampling method and – one as control group and one as experiment group.

6. RESEARCH INSTRUMENTATIONS
Considering the hypotheses, mathematics exams and Algebrator software were used in the study. The 14 questions of the pre-test were pertinent to mathematical concepts of fundamental concepts of math. Another 8 questions of post-test concerned about the contents of what is educated in experiment and control groups. Total point of each test was 20 and content reliability of the test and software was confirmed by well experienced professors and experts. Regarding reliability of the exam, total odd and even questions for each student was calculated and the results were verified through split-half method with 75 percent value.

6.1. INTRODUCTION TO ALGEBRATOR SOFTWARE
The software is computer Algebraic system (CAS) first introduced by Neven Jarkovis of Soft Math, San Antonio, Texas in late 1990s. It is the only Algebra specialized system which mainly focuses on math education. The user can observe the process through a stepwise process. The software can be used as electronic teacher for students at different levels. Problems of elementary to advanced level about triangles, statistics, etc. are covered by the software. It is not an independent initiation and suits solving wide range of mathematic questions. The first noticeable point when working with the product is its user-friendly design. For beginning a blank page (resembling a notebook), draw attention of the user. Materials can be adopted relative to problem under consideration (e.g. equation, inequality, mixed number, series, function, statistics, etc.). Among many topic “matrix” is covered in what follows:
Matrixes multiply: trains how to multiply two matrixes though the steps pictured in Figures 2 and 3. The student receives explicit and adequate explanation of the topic. The two windows pictured below demonstrate how to multiply two matrixes, obtain final matrix and extra details on the process.
7. DATA COLLECTING AND ANALYZING
Two out of the five classes were adopted and final points of the last semester in math were compared between the two classes. By finding a measure of classes development level, one of randomly adopted to be instructed using traditional method and the other class was adopted for software-based education. Topics such as matrixes and some parts of triangles were covered during the course. Finally, a post-test was performed for both classes. Mean and Std were used for analyzing descriptive data. Regarding deductive data, One-Sample Kolmogorov-Smirnov test, Leven, and independent samples T-test were carried at significance level of 0.05.

8. FINDINGS
Table 1 lists standard deviation and average for surveying descriptive data. The Table 1 represents that means of both groups are equal in the pre-test, while experiment group obtained higher mean comparing with the control group. In addition, dispersion of score (standard deviation) was higher for the control group.
Table 1 - Descriptive statistics

<table>
<thead>
<tr>
<th></th>
<th>pre-test experiment group</th>
<th>pre-test control group</th>
<th>post-test experiment group</th>
<th>post-test control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Mean</td>
<td>18.14</td>
<td>18.11</td>
<td>16.63</td>
<td>13.98</td>
</tr>
<tr>
<td>Std</td>
<td>1.76</td>
<td>1.38</td>
<td>2.01</td>
<td>2.87</td>
</tr>
</tbody>
</table>

Fig.4 illustrates the diagrams of average scores for the two groups. Clearly, experiment group’s bar is lengthier than that of control group.

![Means diagram for control and experiment groups](image)

One-Sample Kolmogorov-Smirnov test were used to check normality of the data. The results of the test show that scores in control and experiment groups are normal (P>0.05). That is, parametric tests can be used.

Table 2 - One-Sample Kolmogorov-Smirnov’s test results

<table>
<thead>
<tr>
<th></th>
<th>pre-test experiment group</th>
<th>pre-test control group</th>
<th>post-test experiment group</th>
<th>post-test control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Sig</td>
<td>0.23</td>
<td>0.9</td>
<td>0.37</td>
<td>0.93</td>
</tr>
</tbody>
</table>

Results presented in Table 3 (Leven’s test) show that the variances are equal (P>0.05). While results of mean equality comparison tests on independent samples shown no significant difference between means of control and experiment groups (P>0.05) (i.e. students in the both groups have equal scientific level).

Table 3 - Results of tests on independent samples for pre-tests

<table>
<thead>
<tr>
<th>Pretests</th>
<th>Leven’s Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig</td>
<td>t</td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>0.87</td>
<td>0.35</td>
<td>-0.19</td>
</tr>
<tr>
<td>Equal Variances not assumed</td>
<td>-0.19</td>
<td>39.9</td>
<td>0.84</td>
</tr>
</tbody>
</table>

The results from Leven’s test (Table 4) shows that the variances are equal (P>0.05). Moreover, the results of comparison of equality means of independent samples shown a
significant relation between means for experiment and control groups’ post-tests (P<0.05). Thus, the software was positively effective on math learning of the students.

Table 4- Results of tests on independent samples for post-tests

<table>
<thead>
<tr>
<th>Post-tests</th>
<th>Leven’s Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig</td>
<td>df</td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>3.93</td>
<td>0.06</td>
<td>-3.53</td>
</tr>
<tr>
<td>Equal Variances not assumed</td>
<td>-3.53</td>
<td>37</td>
<td>0.001</td>
</tr>
</tbody>
</table>

9. DISCUSSION AND CONCLUSION
The 21st century is known as the age of wisdom and information explosion. That is, knowledge, information, and wisdom are the main assets of individuals, nations, and communities. Education is undergoing a trend to pass the national borders. The new age has brought electronic learning as one of the most important learning methods, which has been faced with considerable acceptance. Traditional education system is not the only way of learning and teaching and teachers are the only providers of education services. Evolvement of information and scientific networks in the world has resulted in evolution in the meaning of school and no single school is off the hook in this general trend. The main hypothesis of the study was confirmed. So that average post-test score of experiment group was higher than that of control group. One explanation for the results is undeniable role of information technology and math training software on developing of access to information and knowledge in this regard and, consequently, students have new ways to touch information and knowledge. On the other hand, users have developed new viewpoints in this regard. For future studies, we recommend; 1- further study on the effect of educational software on other fields; and 2- exploration of the effects of such software on teachers and parents. Regarding limitation of the study, lack of adequate computer knowledge of the instructors and limitation to high-school level are two to name.

References
