Comparison of the Effect of IT and Puzzle-Based Teaching Methods with Respect to the Lecturing Method in the Educational Progress of the Computer Science Basics Course of High School’s 3rd Grade of Math-Physics Students of Urmia’s 1st District

Elham Ghavami
Department of Education, 1st District, Urmia, Iran
Elham.Ghavami1349@yahoo.com

Abstract

The current study was aimed at comparing the impact of IT-based, puzzle-based, and lecturing teaching methods in the academic achievement of computer science basics course among third grade high school mathematics students in District one of Urmia City. This was a test study of pretest and posttest type with control group. The statistical population included female third grade high school mathematics students in Urmia City District one in the academic year 2014-2015. Through cluster sampling, 60 students were randomly selected and put into test (IT and puzzle) and control (lecture) groups. The curricula were executed by the researcher, and the academic achievement of students was evaluated with the first semester score as pretest and the second semester score as posttest. Analysis of covariance and Bonferroni’s post hoc test for pairwise comparisons were used to analyze the research data. Findings indicated that IT-based and puzzle-based teaching methods influenced the academic achievement of students. Moreover, puzzle-based teaching method influence the academic achievement of students more than IT-based, and IT-based teaching method was more effective in comparison with lecturing method.

Keywords: IT-Based Teaching Method, Puzzle-Based Teaching Method, Lecturing Method, Academic Achievement.
Introduction
One of the main occupations of mankind has always been enabling the future generation to manage their affairs and take over the cultural heritage for all. The largest part of this responsibility was taken by the family at first. With the development of society and division of labor, the task of education was assigned to the institution of education and training. Nowadays, the concept of education has changed and its domain has expanded due to the increasing development of sciences and technology along with new findings in education psychology (Khadivi, Aghdasi and Samadian, 2012). One of the main problems of education is the academic achievement of students which is one of the important indices in the evaluation of education. It is used to help different areas such as cognitive, emotional, and personality dimensions for the growth and excellence of individuals (Jamali, Nowrouzi, and Tahmasibi, 2013). Academic achievement refers to an effect (image) of students’ academic positions. This image may express a score for a period, an average score in a period pertaining to a subject or the average score pertaining to different periods (Varzdar, 2009).

In the meantime, one of the main problems of education system and academic achievement of students is the extreme use of inactive and traditional teaching method by the teachers. The primary objective of teaching is to convey information from teacher’s mind to that of student. Therefore, creativity and innovation, growth of emotions and feelings, and development of attitudes and values are not taken into accounts among students. Thus, teaching method may be one of the factors resulting in behavioral and disciplinary problems in the classroom (Abiri, Sadeghi, Khosro Javid, and Ofoghi, 2014).

It means that the teacher has an active role in traditional teaching methods and presents the materials orally in classroom. Without having an active role, the students should only listen to the teacher and memorize the desired materials. In such circumstances, the academic achievement and intellectual growth of students are under unfavorable influences. Therefore, nowadays, the subject of active teaching methods and active learners has a special position in education topics (Keramati, 2005).

The use of information and communication technology is a part of movement towards better application of educational technology in modern schools (Higgins, 2003). Nowadays, the applications of computer have a unique role in teaching computer basics. Providing the students with more chances for observation, discussion, and analysis, ICT can make computer basics more appealing, correct and appropriate for students. Having a positive impact on teaching and learning computer basics, it can provide them with more opportunities to make contacts and cooperate with each other (Karami, 2009). In a study, Monky (2009) stated that the rate of using virtual education has dramatically increased used and believed that the creation of necessary space for experiencing the natural world and its each part’s functions would definitely be much more effective in comparison with presenting virtual images. In another study, Wighting (2006) investigated the impact of computer on the feeling of being a member of class society. The results indicated that the use of computer in the classroom had positive impacts on students and their academic success. In another study, Najafi (2006) indicated that the third grade students who learned mathematics with computer-assisted teaching method had higher academic achievement and more enthusiasm than those who participated in traditional classes for mathematics.
Another modern teaching method, which is based on cooperative learning, is puzzle-based teaching. This method was first introduced by Aronson in 1970 in order to develop group work skills of learners. This method could improve learning, enhance the motivation of learners and the extent to which they enjoy learning experiences (Aronson and Yates, 1983). Regarding puzzle-based teaching, some pundits believe that competent students benefit from cooperative learning methods (puzzle) as much as weak students because they are encouraged by group for their success. Learning how to teach, their morale is improved so that they gain self-confidence (Harden, 2003).

In a study, Fischer & Shachar (2004) investigated the effect of cooperative learning method (puzzle-based method) on the academic achievement of students. They concluded that students trained this way got higher scores in comparison with the control group. In a research entitled the Impacts of Cooperative Learning on the Achievement and Attitude of the Fifth Grade Students, which was conducted in different cultures of the United States of America, Winston (2002) concluded that cooperative learning (teaching with puzzles) had a positive impact on students’ attitude towards math and their academic achievement in this subject. Furthermore, in a study conducted by Behrang and Aghayari (2011) entitled the Change Caused by Cooperative Teaching of Jigsaw Type in the Traditional Teaching Status among the Fifth Grade Students, the results indicated an obvious difference in the achievement of students in test and control groups, enhanced learning and their academic achievement.

Therefore, the review of literature indicated that lecturing, IT-based and puzzle-based methods were compared with each other with respect to their impacts on many aspects of learners. However, literature review did not indicated any studies in which the impacts of three teaching methods based on the Web, puzzle, and lecturing on the academic achievement of computer basics were compared. Therefore, it appears necessary to compare these teaching methods for the sake of learners’ perception of educational environments. Given what has been mentioned, the question is, “Does the use of teaching methods based on IT and puzzles have a better impact on the learning and academic achievement in computer basics in the female third grade high school mathematics students in Urmia City District one?”

**Research Methodology**

This was a test study of pretest and posttest type with control group. The statistical population included female third grade high school mathematics students in Urmia City District one who enrolled in schools in the academic year 2014-2015. According to the report provided by the Statistics Office of Education Bureau in Urmia, they were estimated at 542 individuals. Among the study population, 60 students were randomly selected and put into two groups of test (20 subjects per each group) and control. Cluster random sampling method was used to select the samples in a way that three high schools were randomly selected from Urmia City District one first. Then, three mathematics-physics classes were randomly selected out of the sample schools for investigation. After that, the students of each class were taught different teaching methods. In other words, the subjects of Test Group 1 were taught with IT-based teaching method; the subjects of Test Group 2 were taught with puzzle-based teaching method; and the subjects of Test Group 3, which was considered control group, were taught with lecturing method.
Research Tools

Academic Achievement Score
In this study, the academic achievement score was calculated on the scores pertaining to the first and second semesters.

Lecturing Teaching Method (Control Group)
In this method, verbalization is used, and the teacher speaks rather continuously in the classroom while the students listen and take notes. The materials are expressed point by point.

Puzzle-Based Teaching Method
The students are divided into groups with 3 to 4 individuals in a computer basics class. The groups were named (A), (B), (C), (D), and so on. Finally, each student returns to the corresponding group and tries to provide it with a completely systematic report. The situation is organized in a special way. The only way for each member to access the information of other individuals is to carefully listen to the report presented by them. Therefore, if each student does not like her classmate or get along with her, she cannot succeed in the upcoming test. To increase the probability that each report is correct, the students do not immediately return it to their group. It is required that each of these groups would form a new group with the members of other groups who are responsible for studying a common part.

IT-Based Teaching Method
In this method, after entering the classroom and greeting, if there is a special occasion, it will be discussed with respect to its importance. Otherwise, if there is another topic (such as the exam in previous hour) about which almost everyone is talking, a few minutes are spent listening to it. Then, the physical and mental status of learners are considered after calling the roll. Checking the homework assignments and reviewing the previous lesson, the new lesson starts. Furthermore, talking a few words about the new lesson and its usages, the students are motivated more to learn it. Lessons are presented in Multi Medial Builder which is a content-producing application accompanied by a data projector.

After coordinating the necessary affairs and getting the authorization from Education Research Council in West Azerbaijan Province, the schools were selected randomly. After choosing the schools, the necessary actions were taken to make the students understand the research objectives and encourage them to participate in the desired training course. On the day of conducting the project, lecturing group was first present in a rather large and well-lit class in the traditional method. Initially, pretest (academic achievement score) was obtained, then the lesson was presented in traditional lecturing method. Presenting goals, making examples, concluding and summarizing the materials, it was tried to increase the level of concentration and attention among students. Due to the coordination between the representatives of both groups, puzzle group entered the class immediately after the first class was over, and lecturing group left the class. After obtaining the average score pertaining to the first semester for puzzle group, this group was divided into some other groups on which the method of executing puzzle was implemented. In the end, posttest (the second semester score) was given to this group. After this group, the students of IT-based group were also given the pretest (the first semester average score) like other groups, and then IT-based teaching method
was executed on it. Finally, posttest (the second semester average score) was given to this group. Control group did not receive any teaching methods.

Analysis of covariance and descriptive statistics were used to analyze the research data, and Bonferroni’s post hoc test for pairwise comparisons was used to compare the groups.

**Findings**

The demographic findings indicated that the highest average age of students was observed in the lecturing teaching group with an average of 17.06, whereas the lowest average age was observed in IT-based teaching group with an average of 16.53. Moreover, there were more than two children in the families of IT-based, puzzle-based, lecturing, and control groups. In other words, the majority of students lived in families with more than two children. On the other hand, the students participating in 4 groups were excessively dependent on their parents. Furthermore, 14 mothers of puzzle group participants used the Internet. After that, there was control group. Finally, only two mothers of IT-based teaching group participants used the Internet, whereas 13 fathers participating in puzzle group used the Internet. Then, there was control group in which 11 fathers used the Internet.

The descriptive indices pertaining to test and control groups can be seen in Table 1 with respect to academic achievement variable.

**Table 1: Descriptive Statistics Pertaining to Academic Achievement Variables**

<table>
<thead>
<tr>
<th>Group</th>
<th>Average</th>
<th>Quantity</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>18.53</td>
<td>19</td>
<td>1.15</td>
</tr>
<tr>
<td>Posttest</td>
<td>19.10</td>
<td>19</td>
<td>1.28</td>
</tr>
<tr>
<td>Puzzle group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>19.81</td>
<td>20</td>
<td>0.47</td>
</tr>
<tr>
<td>Posttest</td>
<td>20</td>
<td>20</td>
<td>0.01</td>
</tr>
<tr>
<td>Lecturing group (Control)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>17.32</td>
<td>15</td>
<td>3.05</td>
</tr>
<tr>
<td>Posttest</td>
<td>18.26</td>
<td>15</td>
<td>1.85</td>
</tr>
</tbody>
</table>

The contents of this table indicated that the statistical indices of study groups were not considerably different from each other in pretest, and no notable difference was observed between the groups in terms of variance, although this conclusion was made without statistical support. It means that the pretest pertaining to academic achievement in IT test group, puzzle test group and control group were 18.53, 19.81 and 17.32, respectively. Moreover, the contents also indicated that obvious differences were observed in the dependent variable of academic achievement index after teaching independent variables in test groups. On the other hand, no considerable change was observed in dependent variable in the control group which was not subject to educational intervention. It means that the average academic achievement was 19.10, 20, and 18.26 in IT, puzzle, and control education groups in posttest, respectively.

On the other hand, analysis of covariance was used to see whether teaching methods (IT-based and puzzle-based) influenced the academic achievement in computer basics among female third grade high school students. The results can be seen in Table 2.
Table 2: Analysis of Covariance for the Impacts of IT-Based and Puzzle-Based Teaching Methods on Academic Achievement

<table>
<thead>
<tr>
<th>Group</th>
<th>Source of Changes</th>
<th>Total Squares</th>
<th>Degree of Freedom</th>
<th>Average Squares</th>
<th>F</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Achievement</td>
<td>Group</td>
<td>4276.95</td>
<td>2</td>
<td>4276.95</td>
<td>26.34</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Error</td>
<td>7062.83</td>
<td>48</td>
<td>7062.83</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>373227.01</td>
<td>52</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Before the analysis of covariance, Mauchly and Levene’s sphericity and box tests were conducted to comply with the pre-assumptions of ANCOVA. According to the results of box test which were not significant for any of the variables, the homogeneity condition of covariance matrixes was complied with correctly. According to Mauchly’s sphericity test which was not significant for any of the variables, it was assumed that variances were equal inside the subjects. Based on Levene’s test and its insignificance for none of the variables, the equality condition of intergroup variances was followed.

The contents of Table 2 indicated that the combination of IT-based and puzzle-based teaching methods influenced the academic achievement of students (F=26.34 and P=0.001).

Moreover, Bonferroni’s post hoc test for pairwise comparisons was used to find out which group influenced the academic achievement more and to see which groups were significantly different. The results were indicated in Table 3.

Table 3: Results of Bonferroni’s Pairwise Comparisons for Educational Groups

<table>
<thead>
<tr>
<th>Group i</th>
<th>Group j</th>
<th>Mean Differences</th>
<th>Standard Error</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puzzle</td>
<td>IT</td>
<td>3.99</td>
<td>0.79</td>
<td>0.001</td>
</tr>
<tr>
<td>Puzzle (Control)</td>
<td>Lecturing (Control)</td>
<td>0.46</td>
<td>0.78</td>
<td>0.001</td>
</tr>
<tr>
<td>Lecturing (Control)</td>
<td>Lecturing (Control)</td>
<td>3.46</td>
<td>0.81</td>
<td>0.001</td>
</tr>
</tbody>
</table>

According to the data presented in Table 3, there was a significant difference between IT-based and puzzle-based teaching methods. Given the difference between means, it can be stated that puzzle-based method increased the academic achievement of students more than IT-based method did. On the other hand, puzzle-based method influenced the academic achievement of students more than lecturing method did. Moreover, there was a significance difference between IT-based teaching method and lecturing. Considering the difference in mean, it can be mentioned that IT-based method influenced the academic achievement of students to a greater extent.

**Discussion and Conclusion**

The first research finding indicated that there was a significant difference between the pretest and posttest scores of subjects in IT group, and IT-based teaching method influenced the academic achievement of students, making a substantial change. In other words, IT-based teaching method increased the academic achievement of female third grade high school
students in computer basics. This finding was consistent with the result from the studies conducted by Monky (2009), Wighting (2006), Wiburg (2003) and Montazeri (2006) who believed that the use of ICT was effective in the academic achievement and success of students. However, the results from the studies conducted by Adeyemi (2012), Owusu, Monney, Appiah & Wilmot (2010) were not consistent the findings of the current study and other aforementioned ones. In the investigation of the impact of computer-assisted education on the academic achievement of high school students with respect to lessons, Adeyemi (2012) concluded that the use of computer as one of the main forms of ICT did not have a significant impact on academic achievement.

To explain this finding, it can be stated that the interaction of student with teacher and educational content should be taken into account in IT-based system so that the results can be guaranteed because interaction is the most important principle in IT-based electronic learning. In fact, student, teacher and educational content interaction accompanied by multimedia tools would result in the academic achievement of students (Habibi, 2009). Moreover, IT-based teaching method led to higher performances and efforts in the students due to motivation, interest, appealing use of computer and multidimensional media, especially the virtual teaching environment; therefore, the students had a higher academic achievement (Chonsy, 2003).

Consistent with the current research, Najafi (2006) reported that the third grade students who learned mathematics in computer-assisted teaching method showed higher achievement and interest in comparison with those who participated in traditional classes. The results of the study conducted by Sayf (2003) indicated that academic achievement was caused by working with computer and based on the Web in comparison with classes held on campus (traditional and face-to-face) due to attraction and more efforts made by students. Teaching method based on computer and the Web stimulates the personal attention and interesting visual presentations in students through immediate feedback so that they would learn in new ways which traditional teaching cannot handle.

Whipp & Chiareli (2004) also proved that education assisted by modern information technologies would cause the learners to have a high self-regulation in learning because they would do most of their tasks actively, being energetic in searching for new information and sources. Student’s activity and involvement with the problem is one of the important approaches to stable and favorable learning which is taken into account in technological education. In this method, students receive an appropriate feedback and use the required time to learn math in an appropriate way. On the other hand, the students are enabled to perceive the materials more appealingly, variously, and completely by using different capabilities of sound, image, graphics, animation and concurrent multimedia applications which involve several senses simultaneously so that learning motivation would increase. The use of multimedia applications in smart schools would improve information processing procedures. The optimal use of such strategies would expand perceptual processes, facilitate the transfer of cognitive skills and problem-solving process in time. It would also result in self-motivation, self-sufficiency, acquisition of cognitive processes, generalization and multiplication of attention and accuracy or the self-regulation of learners in learning process. Being impervious to oblivion, this impact which was caused in education would be almost constant in time, increasing the academic achievement of students in schools.
The second finding indicated that there was a significant difference between the pretest and posttests of subjects in puzzle group. Making a substantial change, puzzle-based teaching influenced the academic achievement of students. In other words, puzzle-based teaching method increased the academic achievement of female third grade high school students in computer science basics. This finding was consistent with the results from studies conducted by Kilic, 2008; Fischer & Shecher, 2004; Behrangi & Aghayari, 2011; and Zarey & Arezi, 2010. What is observed as a result of investigation in this study is the attention paid to this point that the modern world has characteristics which are really different from recent years. Pundits believe teachers should not teach learners the content. They should teach learners how to learn the content. Palmer (2003) emphasized the participation of learners in the education process due to this reason. In this way, the learning depth of learners is increased, and the responsibility and motivation for learning would be developed among them so that they would be prepared for a lifelong learning (Debessay & Lerner, 2004). Thus, it is not possible to continue the current education system with traditional methods growing the students passive and obedient. The majority of thinkers and socialists believe that multiple opinions in work communities and similar problems are among the main causes of failure in third-world countries. On the contrary, one of the main reasons why developed countries are successful is to motivate the students to do cooperative activities and develop the cooperative spirit among them (Ghahar, Bosliki, and Alemdzadeh Nour, 2009). In fact, the use of learner-decending methods prepares the students for success in group activities in order to have a favorable future. This cannot be achieved unless the students are familiarized with cooperative activities and group work from the very beginning years of education so that the groundwork is set for them to gain useful experiences.

To explain the results of this study, it can also be stated that sense of integration and excessive competition resulted in doing more exercises and repetitions in this teaching method so that learning was improved. Sharan (1980) considered the reason for the academic achievement of cooperative methods to be the fact that cooperative learning would increase the internal motivation of students and results in their progression and success. Slavin (1995) believed that the academic achievement of cooperative teaching methods was due to the impact of group goals because they would make people more responsible and improve the cooperation between them through regularity and integration. In this method, the students are so responsible towards each other that they seem to try hard for their own success because the group success in achieving the goals would require each member to learn the educational materials. The results from many studies indicated that learning through cooperation was more effective in increasing the academic success of students along with the development of their perceptions in comparison with individual or competitive learning (Torabi Zadeh, Fathi Azar, and Rahmani, 2007). The reason is that they first discuss and modify their opinions in oral exercises cognitively against others’ opinions. Second, the students are often involved in a higher learning level in group activities (levels of application, analysis, and evaluation); however, it is not the same in traditional methods which mainly deal with the level of knowledge and perception (Johnson, Johnson & Holubec, 2008).

Equalization of students in IT-based, puzzle-based and lecturing teaching methods with respect to social-economic status can be considered a limitation. This study was conducted on female students in Urmia City. Results should be carefully generalized for the students of
other schools and cities. Given the fact that schools and classrooms were limited to the traditional framework, the unfamiliarity of students with IT-based and puzzle-based teaching methods caused some implementation problems. On the other hand, considering the fact that puzzle-based teaching influenced the learning and academic achievement of students more than IT-based method and lecturing did, it is advised to use this method in the education of higher levels in high school, especially abstract and complicated lessons. It is also suggested that studies should be conducted on the impact of puzzle-based and IT-based methods on the academic achievement of students in other lessons. The results regarding different lessons should be compared with each other. Implementing national plans, the impact of puzzle and IT patterns should also be investigated on the level of knowledge, skill and attitude toward different academic grades.
References


Payami Bousari, Mitra; Fathi Azar, Eskandar; Mousavi Nasab, Nour Aldin (2006). Comparing the Effectiveness of Teaching Methods of Team Members with Lecture Accompanied by Questioning and Answering on the Academic Achievement of Nursing Students, Iranian Journal of Education in Medical Sciences, 6 (2), 45-51.


Jamali, Makiyeh; Nowrozi, Azita; Tahmasbi, Rahim (2013). The Factors Influencing the Academic Self-efficacy and Its Relationship with Academic Success in the Students of Bushehr University of Medical Sciences in 2012-2013. Iranian Journal of Education in Medical Sciences, 13 (8): 629-641.


Khaledi, Shahnaz et al. (2011). The Impact of Lecture Teaching Method and Three Hybrid Cooperative Methods on the Level of Learning and Stable Learning in Nursing Students, Seasonal of Dena, 5 (3 and 4): 3-10


Ghahar, Hadi; Boseliki, Hasan; Alemzadeh Nouri, Muhammad (2009). Teamwork: Requirements and Advantages, Weekly of Pegah Hoze, No. 274

Keramati, Muhammad Reza; Husseini, Maryam (2008). The Impact of Cooperative Learning on the Academic Achievement of Students in Physics. Journal Psychology and Education Sciences, No. 2: 147-165


