Influence of Educational Video Games for the Achievement of the Mathematics and Problem-Solving Abilities of Upper Primary School Students

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ABSTRACT

This study examined post-test performance and retention performance of students in mathematics when learned and problem-solving ability through educational video games and traditional lecture method. The study adopted a quasi-experimental design. The sample was drawn from Alagappa Model Higher Secondary School in Karaikudi at Sivagangai district in southern Tamilnadu. Respondents were 90 students (46 boys and 44 girls). The findings revealed that there was a significant difference in the post-test scores, retention test scores, gender, and localities of experimental and control groups. The study concluded that educational video game learning significantly improves students’ achievement and retention capacity. Therefore, the study recommended that this advent of learning that combines both face-to-face and online delivery can effectively be utilized in learning mathematics and problem solving to enhance the performance and retention among upper primary school students.

KEYWORDS
Education, Mathematics, Problem Solving, Video Game

INTRODUCTION

Over the most recent couple of years instructional games (computer games planned explicitly for preparing or instructive purposes) have picked up consideration as an apparatus for encouraging learning in various areas of society including however not restricted to military, wellbeing, and training. Continuing advances in technology, the increasing popularity of entertainment video games and recent studies that underscore the potential of game-based learning (e.g., Federation of American Scientists, 2006; Egenfeldt-Nielsen, 2005; Mitchell & Savill-Smith, 2004) have renewed interest in the use of instructional games.

Various variables have made instructional games alluring learning devices. The advancement of technology has made it possible to play games on simple platforms such as mobile devices. This makes instructional games accessible to many people including those who do not have personal computers (Mitchell & Savill – Smith, 2004). Instructional games may create a new learning culture that better corresponds with student’s habits and interests (Prensky, 2001). All the more significantly, instructional games are believed to be powerful devices for showing troublesome and complex
methodology because they (a) use action instead of explanation, (b) create personal motivation and satisfaction, (c) accommodate multiple learning styles and skills, (d) reinforce mastery skills, and (e) provide interactive and decision-making context (Charles & McAlister, 2004; Holland, Jenkins, & Squire, 2002; Sheffield, 2005).

Given these benefits, many educators are increasingly interested in using the games in the formal school setting. Report from Federation of American Scientists (2006) suggested that integration of the games into schools could help reform the educational system. “Individuals gain new information, and complex aptitudes from game play, recommending gaming could address one of the country’s most squeezing needs - reinforcing our arrangement of training and getting ready for 21st century jobs” (Federation of American Scientists, 2006, p.3).

Although researchers have been studying problem solving for decades (Jonassen, 2003), the definition of problem solving tends to differ across studies. One definition of problem solving states that it is a higher-order cognitive process and intellectual function (Adachi & Willoughby, 2013).

**REVIEW**

Jonassen (2003) highlighted that problem solving involves cognitive skills that are important in professional workplaces as well as in everyday life. Shute, Ventura, and Ke (2015) identify some characteristics of problem solving which includes: “it is a cognitive process; it is goal directed; and the complexity (and hence difficulty) of the problem depends on one’s current knowledge and skills” (p.13). Furthermore, the process of problem solving entails four aspects: Rule identification is the ability to acquire knowledge of the problem-solving environment. Rule application is the ability to control the environment by applying that knowledge or solving problems by using existing rules. Flexibility is using tools in more creative ways. Resource management is the ability to distribute resource more efficiently and effectively (Shute, Ventura, & Ke, 2015).

Shute and Wang (2015) argued that problem solving is not an innate skill, but rather it is a skill that can be developed when young people have ample opportunities to solve problems. Video game play creates a unique environment that can promote certain cognitive skills and flexibility through problems that encourage players to creatively find a solution to problems or rethink for alternative strategies by using available tools in games (Shute, Ventura, & Ke, 2015). This skill is fundamental because the way in which students learn how to solve problems and use different strategies might have an influence on their ability to understand a problem and solve it, as well as apply the same skills to the world around them. In other words, playing video games may provide an appropriate environment for players to develop problem solving skills. Although there are studies that examined video games and problem-solving skills (Adachi & Willoughby, 2013), no research that has explored different types of video game play and problem-solving was found in the literature. Thus, the purpose of this study was determine the influence on educational video game for the achievement on mathematics and problem-solving ability.

**OBJECTIVES OF THE STUDY**

The main objectives of this study the influence on educational video game for the achievement on mathematics and problem solving ability of upper primary school students. The other objectives of this study was,

- To determine the significance of differences in the post-test performance of students learned mathematics and problem solving ability through Educational Video Games (EVG) and those learned to use the Traditional Learning Method (TLM).
• To examine the significance of difference between the retention of students learning mathematics and problem solving ability through Educational Video Games (EVG) and those learned to use the Traditional Learning Method (TLM).

RESEARCH QUESTIONS

The following questions guided this study:

• Is there any difference in the post-test performance of students learned mathematics and problem solving ability using the EVG and those learned to use the TLM?
• Is there a difference between the retention performance of students learned mathematics and problem solving ability using the ELM and those learned to use the TLM?
• Is there a difference exists between gender regarding mathematics achievement and problem solving ability after experimental treatments?
• Is there a difference exists between locality regarding mathematics achievement and problem solving ability after experimental treatments?

RESEARCH HYPOTHESES

Hypotheses were posed to help answer the research questions.

1) There is no significant difference in the post test performance of students learned mathematics through the EVG and those learned with TLM.
2) There is no significant difference in the post test performance of student’s problem solving ability through the EVG and those learned with TLM.
3) There is no significant difference in the retention performance of students learned mathematics through the EVG and those learned with TLM.
4) There is no significant difference in the retention performance of student’s problem solving ability through the EVG and those learned with TLM.
5) There is no significant difference exists between genders regarding post-test scores in mathematics after experimental treatments.
6) There is no significant difference exists between genders regarding post-test scores in problem solving ability after experimental treatments.
7) There is no significant difference exists between localities regarding post-test scores in mathematics after experimental treatments.
8) There is no significant difference exists between localities regarding post-test scores in problem solving ability after experimental treatments.

SIGNIFICANCE OF THE STUDY

Young people are engaged in a variety of extracurricular activities, such as sports, performance, and art groups, and academic clubs. Since the introduction of commercial video games in the 1970s, many young people spend a good proportion of their leisure time engaged in video game play. Initially, research studies focused on the negative outcomes of playing video games (i.e., Breuer, Festl, & Quandt, 2014); however, researchers have begun to document the benefits of playing video games. A shift in researcher interest in the identification of the positive outcomes associated with video game play is now evident in the literature (i.e., Adachi & Willoughby, 2013). For example, newer research includes a focus on the positive influences of gaming on cognitive processes, and the behavioral and educational benefits of video game. However, one area of interest that has not been thoroughly
investigated is the potential positive impact of educational video game on achievement in mathematics and problem-solving. Therefore, the current study explored the influence on educational video game for the achievement on mathematics and problem-solving ability.

RESEARCH METHODOLOGY

To answer the research question a pre-test and post-test Quasi-experimental design were adopted for the present investigation.

SAMPLE

The investigator has chosen a sample for the present study by using purposive sampling technique from the Alagappa Model Higher Secondary School, in Karaikudi at Sivagangai district in southern Tamilnadu. A total sample of 90 students (46 boys and 44 girls) from the middle school students were selected based on their percentage of marks secured in their previous examination and formed a homogeneous group. Further, these 90 students were divided equally using the simple random sampling technique into two groups namely the control group (23 boys and 22 girls) and experimental group (23 boys and 22 girls) and both groups consisted 45, students each. For the control group, the traditional method namely lecture method was followed, whereas for experimental group educational video games method was adopted.

STUDY TOOLS AND PROCEDURE FOR IMPLEMENTATION

To respond the study questions and main objectives, the investigator selected the unit entitled ‘Algebra’, in the mathematics textbook for 8th standard. Further, the unit content was analyzed and numerous learning objectives were recognized. After the identification of the unit, the investigator showed the related educational video games comprised of a content-based unit, various activities. Then the investigator developed a Mathematic Achievement Test (MAT) and Problem Solving Ability Test (PSAT) to measure the academic achievement level among 8th standard students, which consisted of 20 questions of multiple-choice questions and dichotomous questions. The reliability of the Mathematics Achievement Test and Problem Solving Ability Test using Cronbach Alpha was 0.88. The pre-test was administered at the beginning of the experimentation to both control and experimental groups. Investigator administered the EVG on experimental group and TLM on control group for four weeks. At the end of the treatment, control and experimental groups responded to the post-test. After a month of the experimentation period, a retention test was conducted to determine the retention level of the students.

STUDY VARIABLES

The independent variables in the study are educational video games and traditional learning method and the dependent variable of the study is mathematics achievement and problem solving ability.

STATISTICAL TREATMENTS

Data obtained from the research is analyzed with the Statistical Package for Social Sciences (SPSS), and all objectives are tested at the 0.99 confidence interval. Parametric tests are used in the analyses with the assumption of typically distributed data. The researcher used the descriptive analysis (Mean & SD) and differential analysis (‘t’ test) to find out the effectiveness of the EVG on students’
performance and retention. An independent sample t-test is used for comparison of independent variables, paired-samples t-test is used for comparison of dependent variables.

RESULTS

To establish the homogeneity of control and experimental groups, the significance of differences between the mean values of pre-test scores of the groups are calculated by using ‘t’ test. The results are shown in table (1)

Table 1. Significance of differences between pre-test mean value scores of control and experimental groups

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Calculated ‘t’ value</th>
<th>Remarks at 5% Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>45</td>
<td>33.40</td>
<td>8.228</td>
<td>1.175</td>
<td>NS</td>
</tr>
<tr>
<td>Experimental</td>
<td>45</td>
<td>11.23</td>
<td>11.767</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1 shows at a glimpse that the difference between the control and experimental groups was insignificant as the mean score and standard deviation for the control group are 33.40 and 8.228 respectively while for the experimental group 11.23 and 11.767 respectively. The calculated value of t-test is 1.175 which is not significant at the 0.01 level. The result reveals there is no statistically significant difference between the mean values of students of control and experimental groups in the pre-test. Thus, the homogeneity of the groups is well-established before treatment.
RESULTS ON HYPOTHESES

H1: There is no significant difference in the post-test performance of students learned mathematics through the EVG and those learned with TLM.

Table no (2) describes the analyses for testing this hypothesis,

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Calculated ‘t’ value</th>
<th>Remarks at 5% Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>45</td>
<td>39.27</td>
<td>3.413</td>
<td>53.003</td>
<td>S</td>
</tr>
<tr>
<td>Experimental</td>
<td>45</td>
<td>105.77</td>
<td>6.867</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2 shows that the difference between the control and experimental groups was significant as the mean score and standard deviation for the control group are 39.27 and 3.413 respectively while for the experimental group 105.77 and 6.867 respectively. The calculated t-test value is 53.003 which is statistically significant at the 0.01 level. Here, the null hypothesis is not rejected. This result indicates that there was a significant difference in the students learned mathematics using EVG and those learned to use the TLM as reflected in the mean and SD. The use of EVG is more effective than TLM regarding student’s performance in Mathematics achievement.

Figure 2. Graphical representation of control and experimental groups in their post –test performance of students learned mathematics
H2: There is no significant difference in the post test performance of student’s problem solving ability through the EVG and those learned with TLM.

Table 3. significance of difference between control and experimental groups in their post-test performance of student's problem solving ability

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Calculated ‘t’ value</th>
<th>Remarks at 5% Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>45</td>
<td>33.67</td>
<td>9.308</td>
<td>1.340</td>
<td>NS</td>
</tr>
<tr>
<td>Experimental</td>
<td>45</td>
<td>30.33</td>
<td>23.084</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3 shows that the difference between the control and experimental groups was significant as the mean score and standard deviation for the control group are 33.67 and 9.308 respectively while for the experimental group 30.33 and 23.084 respectively. The calculated t-test value is 1.340 which is not significant at the 0.01 level. Here, the null hypothesis is rejected. This result indicates that there was a no significant difference of students problem solving ability using EVG and those learned to use the TLM as reflected in the mean and SD. The use of EVG is more effective than TLM regarding student’s performance in problem solving ability.

H3: There is no significant difference in the retention performance of students learned mathematics through the EVG and those using the TLM.
Table no (4) describes the analyses for testing this hypothesis,

Table 4. Significance of difference between control and experimental groups in their retention-test performance of students learned mathematics

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Calculated ‘t’ value</th>
<th>Remarks at 5% Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>45</td>
<td>36.70</td>
<td>3.436</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>45</td>
<td>80.53</td>
<td>6.962</td>
<td>31.598</td>
<td>S</td>
</tr>
</tbody>
</table>

Table 4 shows that the difference between the control and experimental groups was significant as the mean score and standard deviation for the control group are 36.70 and 3.436 respectively while for the experimental group 80.53 and 6.962 respectively. The calculated t-test value is 31.598 which is statistically significant difference in the retention scores of students learned mathematics using EVG and those learned using the TLM as reflected in the mean and SD. Here, the null hypothesis is not rejected. The use of EVG is more effective than TLM in terms of retention level of the students.

Figure 4. Graphical representation of control and experimental groups in their retention-test performance of students learned mathematics

H4: There is no significant difference in the retention performance of student’s problem solving ability through the EVG and those learned with TLM.

Table no (5) describes the analyses for testing this hypothesis,
Table 5 shows that the difference between the control and experimental groups was significant as the mean score and standard deviation for the control group are 35.75 and 5.271 respectively while for the experimental group 35.42 and 4.437 respectively. The calculated t-test value is 0.298 which is statistically significant at the 0.01 level. Here, the null hypothesis is rejected. This result indicates that there was a no significant difference in the retention scores of students problem solving ability using EVG and those learned to use the TLM as reflected in the mean and SD. The use of EVG is more effective than TLM regarding student’s performance in the retention scores of student’s problem solving ability.

Table 5. Significance of difference between control and experimental groups in their retention-test performance of student’s problem solving ability

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Calculated ‘t’ value</th>
<th>Remarks at 5% Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>45</td>
<td>35.75</td>
<td>5.271</td>
<td>0.298</td>
<td>NS</td>
</tr>
<tr>
<td>Experimental</td>
<td>45</td>
<td>35.42</td>
<td>4.437</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5. Graphical representation of control and experimental groups in their retention-test performance of student’s problem solving ability

H₅: There is no significant of difference exists between genders in terms of post-test scores in learned mathematics after experimental treatments.

Table no (6) describes the analyses for testing this hypothesis,
Table 6 shows that the difference between the control and experimental groups was significant as the mean score and standard deviation for the control group are 37.20 and 5.743 respectively while for the experimental group 33.98 and 3.034 respectively. The calculated t-test value is 3.140 which is statistically significant at the 0.01 level. Here, the null hypothesis is not rejected. This result indicates that there was a significant difference between genders in terms of post-test scores in learned mathematics after experimental treatments using EVG and those learned to use the TLM as reflected in the mean and SD. The use of EVG is more effective than TLM regarding student’s performance in learned Mathematics.

Table 6. Significant of difference exists between genders in terms of post-test scores in learned mathematics after experimental treatments

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Calculated ‘t’ value</th>
<th>Remarks at 5% Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>45</td>
<td>37.20</td>
<td>5.743</td>
<td>3.140</td>
<td>S</td>
</tr>
<tr>
<td>Experimental</td>
<td>45</td>
<td>33.98</td>
<td>3.034</td>
<td>1.181</td>
<td>NS</td>
</tr>
</tbody>
</table>

Table 7. Significant of difference exists between genders in terms of post-test scores in problem solving ability after experimental treatments

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Calculated ‘t’ value</th>
<th>Remarks at 5% Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>45</td>
<td>35.13</td>
<td>4.587</td>
<td>1.181</td>
<td>NS</td>
</tr>
<tr>
<td>Experimental</td>
<td>45</td>
<td>36.48</td>
<td>5.287</td>
<td>1.181</td>
<td>NS</td>
</tr>
</tbody>
</table>

H6: There is no significant difference exists between genders regarding post-test scores in problem solving ability after experimental treatments.

Table no (7) describes the analyses for testing this hypothesis,
Table 7 shows that the difference between the control and experimental groups was significant as the mean score and standard deviation for the control group are 35.13 and 4.587 respectively while for the experimental group 36.48 and 5.287 respectively. The calculated t-test value is 1.811 which is not significant at the 0.01 level. Here, the null hypothesis is rejected. This result indicates that there was a no significant difference between genders in terms of post-test scores in problem solving ability after experimental treatments using EVG and those learned to use the TLM as reflected in the mean and SD. The use of EVG is more effective than TLM regarding students’ performance in problem solving ability.

H7: There is no significant difference exists between localities regarding post-test scores in mathematics after experimental treatments.

Table no (8) describes the analyses for testing this hypothesis,

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Calculated ‘t’ value</th>
<th>Remarks at 5% Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>45</td>
<td>49.72</td>
<td>7.252</td>
<td></td>
<td>S</td>
</tr>
<tr>
<td>Experimental</td>
<td>45</td>
<td>51.33</td>
<td>5.228</td>
<td>0.018</td>
<td>S</td>
</tr>
</tbody>
</table>

Table 8 shows that the difference between the control and experimental groups was significant as the mean score and standard deviation for the control group are 49.72 and 7.252 respectively while for the experimental group 51.33 and 5.228 respectively. The calculated t-test value is 0.018 which is statistically significant at the 0.01 level. Here, the null hypothesis is not rejected. This result indicates that there was a significant difference between localities regarding post-test scores in mathematics after experimental treatments using EVG and those learned to use the TLM as reflected in the mean
and SD. The use of EVG is more effective than TLM regarding student’s performance in learned Mathematics.

Figure 8. Graphical representation of localities in terms of post-test scores in mathematics after experimental treatments

![Graphical representation of localities](image)

H8: There is no significant difference exists between localities regarding post-test scores in problem solving ability after experimental treatments.

Table no (9) describes the analyses for testing this hypothesis,

Table 9. Significant of difference exists between localities in terms of post-test scores in problem solving ability after experimental treatments

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Calculated ‘t’ value</th>
<th>Remarks at 5% Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>45</td>
<td>51.50</td>
<td>9.279</td>
<td>0.814</td>
<td>NS</td>
</tr>
<tr>
<td>Experimental</td>
<td>45</td>
<td>49.67</td>
<td>6.086</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 9 shows that the difference between the control and experimental groups was significant as the mean score and standard deviation for the control group are 51.50 and 9.279 respectively while for the experimental group 49.67 and 6.086 respectively. The calculated t-test value is 0.814 which is statistically significant at the 0.01 level. Here, the null hypothesis is rejected. This result indicates that there was a no significant difference between localities regarding post-test scores in problem solving ability after experimental treatments using EVG and those learned to use the TLM.
as reflected in the mean and SD. The use of EVG is more effective than TLM regarding student’s performance in problem solving ability.

DISCUSSION OF RESULTS

As an conclusion, from the discoveries of this investigation, educational video games as an advantageous action to classroom learning expedites huge and beneficial outcome of students’ maintenance and dominance of multiplication tables when contrasted with students who depend just upon formal study hall guidelines. As far as age factor, despite the fact that young girls students scored marginally profoundly by and large contrasted with boy’s students, the thing that matters was huge; at the end of the day, age isn’t a factor in the usage of educational video games as learning movement. When comparing urban students and rural students, although it was interesting to find out that the mean score for rural students were higher compared to urban understudies, the thing that matters was not huge which recommend that the impact of educational video game in this examination doesn’t rely upon students’ land status at any rate for the extent of this investigation. Be that as it may, it was fascinating to discover that there was a critical distinction as far as mean score among the normal students contrasted with underneath normal or more normal understudies. It would be a significant research to discover further in exploring the explanations for this finding.

CONCLUSION

The investigation will have its effect on the future educational program of tomorrow’s general public to keep the country side by side with the headway of innovation in training and to be at standard with other created nations which have progressively grasped the idea of computerized game in their instruction framework. The mechanical change has changed various pieces of our present
educational circumstances. Educational Video Games, M-learning, Blended learning, Virtual learning, Gamification, and Artificial Intelligence in training has rolled out a huge improvement in teaching method. Prior to the usage of these inventive procedures, it is vital to test the ground reality at net root level. Henceforth, this exploration planned at investigating the impact of instructive computer games for the arithmetic accomplishment of center school understudy. The outcome uncovered that understudies who learned through the educational video games system got higher scores in the science scholarly execution than understudies who learned through the conventional learning technique. It likewise prove that the maintenance execution of understudies in science was high in instructive computer games. Also, there were no factually noteworthy contrasts among young men’s and young ladies’ understudies of test bunch as far as science scholastic accomplishment. The discoveries urge educators of arithmetic to use the instructive computer games as it’s upgraded the science accomplishment and maintenance of understudies.

RECOMMENDATIONS

Based on the findings and conclusions of this study, the following recommendations were prescribed:

Giving proceeding with supervision to understudies while they play the educational video games. School specialists ought to create norms of value care and techniques as manual to be accessible to all educators in utilizing PCs and other digitalized materials.

Quality specialists with shifted encounters ought to be doled out in schools to offer direction to instructors while the understudies utilize any digitized materials. Those specialists ought to have well-characterized duties and experience.

Parent instructors meeting ought to remember the sessions for which mindfulness is given to the guardians additionally about the educational video games.

Appropriate techniques to manage understudies ought to be given to the instructors and guardians. The works of the educators and understudies ought to be credited and increased in value by the leader of the association and instructors ought to recognize the understudies’ advantages. The tended to requirements ought to be satisfied right away.

Educational video games are the best device for control engine action of the youngsters. Along these lines, school organization urges the understudies to give instructive videogames during their group hours.

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Praveen Kumar G. currently works at the Department of Education, Alagappa University. Praveen does research in Higher Education, Curriculum Theory and Educational Technology. Their current project is 'Effectiveness of Video Games in Enhancing Problem Solving and Pro-social Behaviour of Primary School Students'.

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