# The Effectiveness of Algebrator in The Learning Performance in Mathematics of Grade 11 Students

**Edwardo R. Villahermosa**

General Santos City National High School
Department of Education

DOI: 10.29322/IJSRP.12.03.2022.p12359
http://dx.doi.org/10.29322/IJSRP.12.03.2022.p12359

Paper Received Date: 18th March 2022
Paper Acceptance Date: 25th March 2022
Paper Publication Date: 29th March 2022

***Abstract***

This research determined the effectiveness of using the Algebrator in improving students' learning performance in Mathematics. This utilized the Non-Equivalent Pretest-Posttest Quasi-experimental design type of research. The pre-test and post-test scores were used to determine the effects of integrating Algebrator application software in the teaching and learning process. The subjects of the study were the Grade 11 students at the Senior High School Program of General Santos City National High School. Results of this research revealed that at the start of the experiment, the two groups of subjects have similar knowledge of the lessons. At the end of the experiment, posttest scores show that the group of subjects who were exposed to conventional teaching and learning strategy have improved their learning performance in Mathematics. Likewise, subjects who were exposed to utilizing Algebrator as an aid in teaching and learning improved their learning performance. Using a conventional teaching strategy as well statistically improved the learning performance of the control group. In the experimental group, the improvement in their learning performance was statistically significant. Furthermore, results show that learners who were exposed to utilizing Algebrator as an aid in teaching and learning perform better than those who were exposed to conventional teaching and learning strategies. Thus, using Algebrator as an intervention was further effective in improving the learning performance of the learners as compared to simply using conventional teaching method. This resulted in the recommendation that Mathematics teachers should utilize Algebrator as an aid in teaching and learning to maximize students' participation during classes and to reinforce students' learnings even at home. Also, a training program in utilizing Algebrator application software is recommended for teachers teaching Mathematics.

***Index Terms***- Algebrator, Grade 11 students, learning performance, Mathematics

## I. INTRODUCTION

The fast-growing growth of technology in today's age, specifically in the Information and Communication Technology field, has greatly affected the learning methods both in and outside the school setting. Computer technology concretes the track for a lifetime learning improvement, and many had enjoyed what they need to know by stress-free access to information.[14] So, educational technologies in training and learning are shifting the traditional class frame into a self-motivated environment for fostering creativity, innovation, and assisting learning.[16] Technology-based knowledge, these days, is available in many developed countries and even in developing countries. Literature had shown that software-based learning is confirmed to be an effective tool to meet the goals of quality education.

Technology application in the teaching and learning process in schools has fascinated a lot of consideration in today's 21st-century education. This technological age delivered an ironic learning condition that emboldens social collaboration, critical thinking skills and a comprehensive indulgence of students' learning. This has taken about the insistence to integrate technology in classroom settings.

Classroom teaching experience must be appealing and rationally motivating to motivate students in learning Mathematics. Thus, the learning process reflected using software technology will be able to afford for such situations. Correspondingly, the National Council of Teachers of Mathematics in the paper Principles and Standards for School Mathematics, reflected technology as one of the important principles to enhance the quality of Mathematics.[19] They suggested that teachers must use technology to intensify their students' learning opportunities by selecting or creating Mathematical tasks that take advantage of what technology can do mightily and in graphing, visualizing, and figuring. In today's age of technology, it is imperative to keep up with the contemporary interventions and innovations comparative to technology to meet its significance for the present and future.[9]

In this fast-varying environment, the scholastic system should come together with how technology does evolve. According to Fluck (2010), Information and Communication Technology (ICT) played as a renovation in education rather than integration into current subject areas.[6] This transformative observation of ICT in education requires educators to look at what innovative ways of instructions and curriculum are appropriate for a new generation in working with new tools.

Further research studies had revealed that the improvement of the computer had conveyed infinite invention and thus school educators need to be experienced enough in using computers so that they would make the best use of its features in teaching and learning.[13] Also, they recommended that the use of ICT must be incorporated in the Mathematics Curriculum in both formal and informal learning. By incorporating ICT into their day-to-day teaching lessons, educators can offer innovative chances for supporting students' learning and cultivating the attainment of Mathematical knowledge and skills.[7] Therefore, the availability of technological tools can boost a student's skills in decision making, reasoning, reflection, and problem-solving.

With the integration of computer technology software in everyday teaching, students can have plenty of benefits to receiving. This hypothesis is supported by the study of Hollebrands (2007) which revealed that technology had facilitated a lot the students to participate well in the classes involving the development of Mathematical knowledge and skills.[8] ICT likewise increases a new dimension to the teaching and learning of Mathematics by supporting students to envisage certain Mathematical theories.[7] They also appealed that the visualization and investigation of Mathematical entities and models in multimedia environments can support understanding in new ways.

The ongoing revolution in ICT has led to new tools for crafting advanced educational environments. In answer to this development, a varied variety of new models of Mathematics instruction is commencing to come into view. Currently, numerous teachers are trying to take benefit of existing technologies in the delivery of teaching and learning developments. The use of ICT such as the Computer-Based Multimedia Application (CBMA) in teaching was well-thought-out as an effective substitute for traditional teaching methods.[3] Accordingly, these technological improvements though can make a substantial change that would significantly improve teaching and learning, will not be effective if active teaching practices are not followed. Therefore, the American Association of Mathematics Teachers has customary instruction requirements of secondary school Mathematics educators to be technologically skilled.[1]

More so, standards have been set by numerous Mathematics education groups for the integration of ICT into Mathematics classrooms and for the preparation of teachers.[5] This includes introducing technology in context, addressing valuable Mathematics with the proper technology, taking advantage of technology, linking Mathematics topics, and integrating various representations.

According to Fiolhais and Trindade (2009), one of the significant details for introducing computer use into Mathematics education was that computers are influential and can speedily process information, thus suitable to implement new methods of learning.[4] The habit of using computer-based Mathematics instruction has stimulated learners' understanding of extent concepts and skills.[12] Several studies in the circulated literature show that there is a strong relationship between the use of computers and learners' academic successes in teaching and learning processes.[2]

Furthermore, computer-aided instruction affords importance and makes direct connections between new skills and the learner's background and understanding.[15] In examining past studies, Taepke in 2007, had studied the use of computer technology in education and his findings validate the positive effect of the use of computer software in the classrooms has on student success.[21]

The use of ICT as a supplement to textbooks in education showed gains in student accomplishment in Math.[11] Learners developed positive attitudes toward Mathematics learning through computer Math gaming. It is also believed that middle school Math Explorer, a computer-aided instruction program software designed to address detailed Math standards, attained significant increases in learner Math scores between pre-test and post-test results.[20] The results of the study recommend that learners should be exposed since it showed noticeable gains with exposure to the Math Explorer computer program.

Mathematics learning is a special case of the other subject in the K-12 curriculum. As perceived, the students' role is practically passive, and the teacher dictates the material or facilitates the learnings. Technology facilitates teachers to control the method adopted for solving the problems in Mathematics. Computer and software can afford real-time feedback to the users and lead the process within a specific framework.

Mathematical reasoning ability, as one of the logical thinking skills, plays significant roles in inferences, as this capability contains skills in drawing an inference based on the right principles and creating a conclusion. The mathematical reasoning process is instigated by categorizing and analyzing facts and information in a Mathematical concept, analyzing relationships between two or more concepts by applying a set of principles that have been proved and formulating temporary conclusions until a conclusion is obtained.[10] Learners' problems in Mathematical reasoning is identified as factors that cause difficulties in the teaching and learning process, where many teachers or educators encounter.

Moreover, the result of the 2003 Trends in International Mathematics and Science Study (TIMSS) was alarming. The results showed that the Philippines ranked 34th out of 38 countries in High School II Math and 43rd out of 46 countries in High School II Science.[17] Likewise, for grade 4, the Philippines ranked 23rd out of 25 participating countries in both Math and Science.[17] In 2008, only the science high schools participated in the Advanced Mathematics category; results showed that the Philippines ranked lowest among ten countries.[19] In the 2018 PISA study, the Philippines ranks last among 79 countries in reading comprehension and also ends up second to the last in mathematics and science. In General Santos City National High School, records show that most of the students in Grade 11 had fairly satisfactory learning progress and achievement. It is expected however that students should have a better or at least a satisfactory learning performance.

Based on the statements above, this research attempted to determine the effectiveness of using the Algebrator software as an aid in teaching Mathematics to improve the student's learning performance.

**RESEARCH QUESTIONS**

This research attempted to determine the effectiveness of using Algebrator in improving Grade 11 students learning performance in Mathematics.

Specifically, the study sought answers to the following questions:

1. What is the learning performance of the two groups of subjects at the start of the experiment?
2. Is there a significant difference in the learning performance of the two groups of subjects at the start of the experiment?
3. What is the learning performance of the two groups of subjects after the experiment?
4. Does using conventional strategies of teaching and learning significantly improve the student's learning performance in Mathematics?
5. Does using Algebrator software as an aid in teaching and learning significantly improve the student's learning performance in Mathematics?
6. Is there a significant difference in the mean gain scores of the two groups of subjects?

## II. RESULTS AND DISCUSSION

Table 1: Learning Performance of the Students before the Experiment

| Score Range | Descriptions | Control Group | | Experimental Group | |
|---|---|---|---|---|---|
| | | f | % | f | % |
| 25-30 | Excellent | - | - | - | - |
| 19-24 | Very Satisfactory | - | - | - | - |
| 13-18 | Satisfactory | *1* | *7%* | *1* | *7%* |
| 7-12 | Fairly Satisfactory | *11* | *73%* | *9* | *60%* |
| 1-6 | Poor | *3* | *20%* | *5* | *33%* |
| **Total** | | ***15*** | ***100*** | ***15*** | ***100*** |
| **Mean Score** | | **8.80** | **Fairly Satisfactory** | **7.93** | **Fairly Satisfactory** |

Based on table 1, results show that more than half of the students *(73%)* in the control group and experimental group *(60%)* got a score ranging from 7-12 which is verbally described as fairly satisfactory. As well, there are three (20%) of the students from the control group and 5 *(33%)* from the experimental group are verbally described as poor in their learning performance in Mathematics. More so, one *(7%)* from each group of subjects had a learning performance of satisfactory, with a score range of 13-18. None of the subjects from the two groups got a score of verbally described as very satisfactory and excellent in their learning performance.

In summary, the control group *(M=8.80)* and experimental group *(M=7.93)* had a fairly satisfactory learning performance before the experiment. This result implies that at the start of the experiment, based on the mean score, students as subjects in this experiment had fairly satisfactory learning of the lessons. Meaning, at the start of the experiment, students-subjects had minimal learning of the topics or the lessons.

Table 2: Difference in the Pretest Scores of the Two Groups

| Groups | n | Mean | SD | t | df | p | Remarks |
|---|---|---|---|---|---|---|---|
| Control | 15 | *8.80* | *2.284* | *0.903* | *28* | *0.374* | *No Significant Difference* |
| Experimental | 15 | *7.93* | 2.764 | | | | |
| **Mean Difference: *0.87*** | | | | | | | |

Furthermore, table 2 shows the test of significance in the difference of learning levels by the two groups of subjects based on their pretest mean scores. To do this, a t-test for independent samples was used. Results of the independent samples t-test showed that the pretest mean scores between the control group *(M = 8.80, SD = 2.284, n = 15)* and the experimental group *(M = 7.93, SD = 2.764, n = 15)* was not statistically significant at the .05 level of significance *(t (28) = 0.903, df = 28, p > .05)*. This suggested that there is no significant difference in the pretest mean score between the control and experimental group.

This implies that the difference is due to random chance. Meaning, there is no significant learning difference in the two groups of subjects before the start of the experiment. Thus, before the experiment was conducted, the two groups have similar learning skills levels in the lessons.

Table 3: Learning Performance of the Students After the Experiment

| Score Range | Descriptions | Control Group | | Experimental Group | |
|---|---|---|---|---|---|
| | | f | % | f | % |
| 25-30 | Excellent | *1* | *3%* | *3* | *10%* |
| 19-24 | Very Satisfactory | *14* | *47%* | *21* | *70%* |
| 13-18 | Satisfactory | *15* | *50%* | *6* | *20%* |
| 7-12 | Fairly Satisfactory | - | - | - | - |
| 1-6 | Poor | - | - | - | - |
| **Total** | | ***15*** | ***100*** | ***15*** | ***100*** |
| **Mean Score** | | **19.60** | **Very Satisfactory** | **23.33** | **Very Satisfactory** |

Based on table 3, results show that more than half of the students *(53%)* in the control group and experimental group *(60%)* had a very satisfactory learning performance in Mathematics with a score range of 18-24. Likewise, there are four students *(20%)* from the control group and one *(7%)* from the experimental group whose learning performance are verbally described as satisfactory in Mathematics. More so, one (7%) from the control group and five *(33%)* from the experimental who had a learning performance of satisfactory, with a score range of 25-30. None of the student-subjects from the two groups got a score of verbally described as poor and satisfactory learning performance in Mathematics after the conduct of the experiment.

In summary, most of the students in the control group *(M=19.60)* and experimental group *(M=23.33)* had a very satisfactory learning performance in Mathematics. This result implies that after the conduct of the experiment, based on the mean score, students as subjects in this experiment had very satisfactory learning of the lessons. Meaning, at the end of the experiment, students-subjects had improved their learnings in Mathematics.

Table 4: Difference in the Pretest and Posttest Scores of the Control Group

| Pair | Number of Pairs | Mean | SD | t | df | p | Remarks |
|---|---|---|---|---|---|---|---|
| Pretest<br>Posttest | 15 | *8.80*<br>*19.60* | *3.489* | *11.989* | *14* | *0.000** | *With Significant Difference* |
| Mean Difference: *10.80* | | | | | | | |

*Significant at α = .05

Results of the t-test for dependent samples showed that the mean difference of the pretest and posttest scores of the control group *(Mean diff = 10.80, SD= 3.849)* was statistically significant at the .05 level of significance *(t = 11.989, df= 14, p <.05)*. The null hypothesis which suggested that there was no significant difference in the pretest and posttest scores of the students under the control group is rejected.

This implies that a significant difference is not due to random chance. Meaning, there is a significant learning difference in the student-subjects when they were exposed to using conventional teaching strategies throughout the teaching and learnings. This strategy is considered therefore effective in improving the learning performance of the students in Mathematics during the teaching and learnings.

Table 5: Difference in the Pretest and Posttest Scores of the Experimental Group

| Pair | Number of Pairs | Mean | SD | t | df | p | Remarks |
|---|---|---|---|---|---|---|---|
| Pretest<br>Posttest | 15 | *7.93*<br>*23.33* | *4.339* | *13.745* | *14* | *0.000** | *With Significant Difference* |
| Mean Difference: *15.40* | | | | | | | |

*Significant at α = .05

As shown in table 5, the results of the t-test for dependent samples showed that the mean difference of the pretest and posttest scores of the experimental group *(Mean diff = 15.40, SD= 4.339)* was statistically significant at the .05 level of significance *(t = 13.745, df= 14, p < .05)*. This implies that a significant difference is not due to random chance. Thus, there is a significant difference in the learning performance of the students before and after they were exposed to utilizing Algebrator in the process of teaching and learning. This utilization of Algebrator in teaching and learning is therefore considered as an effective aid in reinforcing the learnings of the students.

Table 6: Difference in the Mean Gain Scores of the Experimental and Control Group

| Groups | n | Mean | SD | t | df | p | Remarks |
|---|---|---|---|---|---|---|---|
| Control | 15 | *10.80* | *3.489* | *3.20* | *28* | *0.003** | *With Significant Difference* |
| Experimental | 15 | *15.40* | 4.339 | | | | |
| Mean Gain Score Difference: *4.60* | | | | | | | |

*Significant at α = .05

As shown in table 6, results of the independent samples t-test showed that the difference in the mean gain scores between the control group *(M = 10.80, SD = 3.489, n = 15)* and the experimental group *(M = 15.40, SD = 4.339, n = 15)* was statistically significant at the .05 level of significance *(t (28) = 3.20, df = 28, p < .05)*. These results suggested that there was a significant difference in the mean gain scores between the control and experimental group. This means that students under the experimental group performed better in their learning performance as compared to the students under the control group. This implies that students who were exposed to the utilization of Algebrator in the teaching and learning learned more skills and knowledge of the lesson as compared to those students under conventional teaching strategy. As a result, utilizing Algebrator as an aid in teaching and learning is more effective than using a conventional teaching strategy alone.

These results supported Short's (2002) study that when a computer-aided instruction program software was utilized during the learning process, students attained a significant increase in their Mathematics test scores between pre-test and post-test results.[20] The results of the study recommend that learners should be exposed since it showed noticeable gains with exposure to the Math Explorer computer application software.

## III. CONCLUSION AND RECOMMENDATION

The effects of using Algebrator as an aid in teaching and learning had a positive impact on the learning performance of the students. It is apparent in the results that students as subjects of the experiment significantly improved better in their learning performance when both the teachers and learners used the Algebrator in the teaching and learning process as compared to the conventional method. It is therefore concluded that when students were exposed to using Algebrator as an aid in teaching and learning, this resulted in better learning performance.

Based on the results, it is hereby recommended that school administrators should train teachers in using Algebrator as support in teaching and learning Mathematics to improve better students' performance. The mathematics teachers may utilize Algebrator as an aid in teaching and learning to maximize students' participation during classes and to reinforce students' learnings even at home. Also, teachers may use various computer-aided instruction software, not just Algebrator as alternative teaching support that maximizes student participation in the class and in enhancing students' potential. The teaching of other subjects, such as Trigonometry, Geometry and Pre-Algebra, may be delivered with the use of Algebrator to maximize student participation and to improve learners' learning performance.

### ACKNOWLEDGMENT

The author is grateful to the participants of this study and too valuable suggestions and comments of all the people who helped in the success of the conduct of this research.


### REFERENCES


[1] AAPT Committee on Special Projects for High School Physics, (1988). *The Role, Education, and Qualifications of the High School Physics Teacher*, College Park, MD: American Association of Physics Teachers.

[2] Altun, T., Yigit, N., & Alev, N. (2007). The Effects of Computer-Supported Materials on Student Achievements and Perceptions of Science Education. In *Conference IMCL2007, April* (pp. 18-20).

[3] Bakaç, M., Tasoglu, A. K., & Akbay, T. (2010). The effect of computer-assisted instruction with simulation in science and physics activities on the success of student: Electric current. *Eurasian Journal of Physics and Chemistry Education*, *1*(1), 34-42.

[4] Fiolhais, C., & Trindade, J. (2009). Use of computers in physics education. *Proceedings of the" Euroconference'98–New Technologies for Higher Education*.

[5] Flick, L., & Bell, R. (2000). Preparing tomorrow's science teachers to use technology: Guidelines for science educators. *Contemporary issues in technology and teacher education*, *1*(1), 39-60.

[6] Fluck, A. (2010). From Integration to Transform. In A. McDougall, J. Murnane, A. Jones & N. Reynolds (Eds.), *Researching IT in Education Theory, Practice and Future Direction*. London and New York: Routledge.

[7] Hohenwarter, J., Hohenwarter, M., & Lavicza, Z. (2009). Introducing Dynamic Mathematics Software to Secondary School Teachers: The Case of GeoGebra. *Journal of Computers in Mathematics and Science Teaching*, *28*(2), 135-146.

[8] Hollebrands, K. F. (2007). The role of a dynamic software program for Geometry in the strategies of high school Mathematics students employ. *Journal for Research in Mathematics Education*, 164-192.

[9] Idris, N. (2006). Exploring the effects of TI-84 plus on achievement and anxiety in Mathematics. *Eurasia Journal of Mathematics, Science and Technology Education*, *2*(3), 66-78.

[10] Kalantarnia, Z., Rostamy, M., Shahvarani, A., & Behzadi, M. (2012). The study of the application of Algebrator software for Mathematical problems solving. *Mathematics Education Trends and Research*, 1-7.

[11] Ke, F. (2008). A case study of computer gaming for Math: Engaged learning from gameplay? *Computers & Education*, *51*(4), 1609-1620.

[12] Kiboss, J. K. (2002). Impact of a computer-based physics instruction program on pupils' understanding of measurement concepts and methods associated with school science. *Journal of Science Education and Technology*, *11*(2), 193-198.

[13] Kumar, N., Rose, R. C., & D'Silva, J. L. (2008). Teachers' readiness to use technology in the classroom: An empirical study. *European Journal of Scientific Research*, *21*(4), 603-616.

[14] Kusumah, Y. S. (2008). Concept, Development, and Implementation of Computer-Based Learning in High-Order Upgrades Mathematical Thinking. Paper presented at the Inaugural Education Mathematics UPI Bandung.

[15] Langer, J. A. (2001). Beating the odds: Teaching middle and high school students to read and write well. *American Educational Research Journal*, *38*(4), 837-880.

[16] Levin, T., & Wadmany, R. (2006). Teachers' beliefs and practices in technology-based classrooms: A developmental view. *Journal of Research on Technology in Education*, *39*(2), 157-181.

[17] Mullis, I. V., Martin, M. O., Gonzalez, E. J., & Chrostowski, S. J. (2004). TIMSS 2003 international Mathematics report.

[18] National Council of Teachers of Mathematics. (2000). *Principles and standards for /school Mathematics*. Reston, VA: Author.

[19] Olson, J. F., Martin, M. O., & Mullis, I. V. (Eds.). (2008). *TIMSS 2007 technical report*. TIMSS & PIRLS International Study Center.

[20] Short, D. (2002). *Computer-based mathematics instruction: Automated remedial branching* (Unpublished doctoral dissertation). California State University.

[21] Taepke, P. A. (2007). *Effect of computer-aided instruction on grades in middle school algebra*. The University of San Diego.

### AUTHOR

Edwardo R. Villahermosa. Master Teacher 2. General Santos City National High School. Department of Education. Email: edwardo.villahermosa18@gmail.com