

Effects of Using Technology on the Academic Performance in Mathematics of the College Millennial Learners

Chona S. Rizada^{1*}, Raymond P. Rey²

Graduate School, Palawan State University, Puerto Princesa City

Corresponding Author: Chona S. Rizada marizada@psu.palawan.edu.ph

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ABSTRACT

The educational landscape has changed significantly with technology. It affects how people live, work, play, and learn, wherein technology has challenged how education is managed and the methods and strategies in teaching, particularly in mathematics. This research is experimental and employed the multi-group pretest-posttest design to assess the effects of using technology on college millennial students' academic performance in mathematics. The control group was subjected to the lecture-discussion method without using technology, while another section served as the experimental group and was exposed to technology-based instructions. The questionnaire was used to gather data from the respondents to determine the extent level of the effect of technology on student's academic performance in mathematics. The results of the post-test increased significantly, and the experimental group results increased is 2.58 percent higher than controlled group. Teaching using technologies enhanced the student's academic performance in mathematics, and it was concluded that teaching with the aid of technology is better than lecture type or traditional teaching methods.

INTRODUCTION

In its general sense, education is a form of learning in which the knowledge, skills, and habits of a group of people are transferred from one generation to the next through teaching, training, or research (Oduma, C. A., & Ile, C. M., 2014). Currently, the educational landscape has changed significantly with technology (El-Hussein, M. O. M., & Cronje, J. C., 2010). It affects the way people live, work, play, and learn. Technology has challenged how education is managed and the methods and strategies in teaching, mainly in mathematics (Niess, M. L., 2005). In previous years, different schools have been preoccupied with putting computer laboratories in procuring hardware and software to keep abreast with the fast-changing mode of teaching and learning (Selwyn, N., 2018). Teachers are no longer the source of knowledge but a facilitator of technology in the classroom, wherein the students can play an active role in learning and evaluating their learning. Students nowadays are computer generations because of their unique orientation to different computer applications (Palloff, R. M., & Pratt, K., 2013). “They are growing up with computers around them and from an early age they have to understand how to use computers,” as. Thus, it is in need that educational institutions must embrace technology and consider it as a part of the teaching-learning process (Alemu, B. M., 2015). The field of mathematics has benefited from technology throughout its history. Mathematical tools have advanced from the abacus, in can base-10 counting system, to the calculators and computers of today (Swedin, E. G., & Ferro, D. L., 2005). These tools can be used in the classroom to promote higher-level thinking and highlight the links between taught concepts and their real-world applications (Santos, J et al., 2019). The range of instructional technology applicable to mathematics is vast and, at times, overwhelming. Many hardware, software, and online offerings can be implemented in conventional and novel ways to complement the many content, process, and technological standards of successful math instruction (Johnson A et al., 2016). Math students can exercise higher order Conceptualization to focus on “decision making, reflection, reasoning, and problem-solving” (National Council of Teachers of Mathematics), such as by manipulating the variables of an equation and observing its effects on a graphing calculator (Kang, O. K., 2001). Instead of spending a significant amount of classroom time on computation (Berge, Z. L., 1998). Students can focus on higher-level skills and valuable applications of their newfound knowledge.

The learning strategies in teaching mathematics focus more on exposition, practice, and consolidation, wherein the teachers do all the things through discussion, and the student just listens (Kutnick, P. et al., 2005). This makes the subject tiresome to the students, and some even hate mathematics. New strategies have been discovered under the Understanding by Design (UBD) wherein the students participate in discovering techniques to solve practical and environmental problems, which makes a student interested in the subject. A higher level of thinking has been developed, and the teacher serves only as a facilitator of learning. Cooperative learning has also been introduced, and the students have fun solving problems with their group and peers.

Nevertheless, all these strategies will become more interesting with the use of technology).

The National Council of Teachers of Mathematics (NCTM) emphasizes the use of technology in mathematics education. Technology, one of the six principles fundamental to school mathematics programs as outlined by NCTM's Principles and Standards, is "essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning." (Taber, M. R., 2013).

The environments in which students learn and the ways in which people work and live are constantly being transformed by existing and emerging technologies. Technology is essential in teaching and learning mathematics; it influences the mathematics taught and enhances students' learning. Some students perceive mathematics as an incomprehensible collection of rules and formulas that appear in mass and threateningly descend on them (Acharya, B. R., 2017). These students build psychological barriers to proper mathematical understanding and develop anxieties about learning and using mathematics. Mathematics has become a dreaded subject in many educational instructions in the world today (Furner, J., & Berman, B., 2005).

A good mathematics teacher knows how to arouse students' interest. It cannot be denied that meaningful teaching aids and devices very much facilitate the teaching-learning process. Students learn faster when they enjoy the material and the learning process. No longer should our students sit passively in the classroom while their teacher lectures (Adler, J., et al., 2005). Speaking of an earlier generation, "If we teach today's students as we taught yesterday's, we rob them of tomorrow." His statement summed up the importance of technology instruction in education today. Some teachers would probably stay to their strategies in teaching. What the old generation likes may not be the same as what the new generation prefers in life, work, and leisure. Unfortunately, many of the good things enjoyed by the elders when they were students are no longer available to the new generation (Crampton, S. M., & Hodge, J. W., 2009). However, as educational institutions embrace new technologies, traditional educational technology must not be abandoned. There must be a balance of the new and old so that they do not lose track of the finest culture developed over the years. Thus, the researcher undergoes this study to further realize the effects of technology on the student's academic performance.

Students' performance can be measured by giving tests. Through evaluation or testing, evidence of growth and progress of learners towards desired outcomes (Harlen, W. et al., 2002). A systematic review of the impact of summative assessment and tests on students' motivation for learning. Further, justifies that testing is one way of evaluating students' academic performance to provide feedback to teachers and students on how well they are doing in technology instruction (Gibbs, G., & Simpson, C., 2005). Teachers evaluate students' performance simply because they are concerned about whether they can reach the purpose goal of their teaching efforts. Students of lower socioeconomic status tend to use computers for drill-based and repetitive practice (Govindasamy, T., 2001). In comparison, students of higher

socioeconomic status use computers to enhance and develop critical thinking skills. Schools with students from higher socio-economic status backgrounds were found to use technology to promote computer programming and higher-order thinking skills. Students from lower socioeconomic status backgrounds were found to use technology for essential remediation of skills previously taught.

Schools with students from higher socioeconomic status backgrounds were found to have adequate funding for educators to pursue technology literacy in professional development classes (Flanagan, L., & Jacobsen, M., 2003). Schools with students from lower socioeconomic status backgrounds did not incorporate computer training into their professional development. As a result of this lack of training in low-income schools, many educators did not feel comfortable using the technology. They chose to use it for the remediation of skills rather than making it an integral part of daily classroom activities. While students have different experiences using computer technology in school, the primary purpose of technology is to increase students' academic performance (Wise, S., Greenwood, J., & Davis, N., 2011). In today's technologically enhanced society, students are our computer generation. "They are growing up with technology all around them and have an early understanding of how to use computers. Despite such technological advancements in almost every aspect of our society, technology is only now being used to transform education.

Emphasized in her study that the conventional/traditional teaching model has been transformed. Teachers no longer lecture while students passively take notes. The conventional/traditional method of class instruction was the short-term recall of facts. In contrast, using technology in the classroom provides more significant opportunities for deeper foundations of knowledge (Byers, T. et al., 2018). Technology creates and supports more effective learning environments. It allows students to find, recognize and evaluate content. Specifically, the Internet provides communication and discussion on a wide variety of topics with a broad range of people (Anderson, T., 2004). The Internet is a tool that empowers students and encourages active participation in the classroom through interaction. Integrating technology in the classroom allows learning to take on new shapes and forms (Dede, C., 1996).

Today's education also presents new pedagogies. The resurgence of the constructivist model has brought about cooperative and collaborative learning, multiple intelligences, discovery learning, and project-based learning, to name a few (Philen, J., 2016). Some educators have taken a more creative approach by allowing technology to play a role in the teaching and learning process. This study determined the effects of technology instruction on the academic performance of Grade in Mathematics of HEIs their level of academic performance in mathematics based on the pre-test, post-test, and final grades, the extent of the effect on the academic level of performance of the respondents who underwent strategies such as; Teaching Using Technology (Technological Instruction Method); and Lecture Type (Conventional/Traditional Instruction Method), the difference between the student levels of academic performance

that underwent teaching strategy using technology (Technological Instruction Method) and Lecture Type (Conventional/Traditional Method) and the difference between the academic performance during the pretest, posttest, and final grades.

THEORETICAL REVIEW

The National Council of Teachers of Mathematics (NCTM) emphasizes the use of technology in mathematics education. Technology, one of the six principles fundamental to school mathematics programs as outlined by NCTM's Principles and Standards, is "essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning." (Taber, M. R., 2013).

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METHODOLOGY

This research is experimental, a kind of quantitative research method involving the control of a group or class to study the relative effects of various treatments applied to members of the same treatment applied to members of different samples. The researcher employs the multigraph pretest-posttest the effects of using technology on the mathematics students' academic performance in mathematics. The coverage of the lessons was taught during the first semester, specifically algebra. To measure the performance of the groups, the researcher herself prepared pre and posttest. Worksheets, quizzes, and final exams were administered to evaluate academic performance in the first semester. The researcher chose two (2) sections that the researcher is handling for the first semester in college algebra classes at different universities, the researcher preferred the two sections that she/he is handling out of convenience rather than through randomization. This procedure is often used in classroom experiments when experimental and controlled groups are naturally assembled as intact classes. Section 1 was exposed to the lecture-discussion method without using technology, while Section 2 served as the experimental group and was taught the lessons with the use of technology. The questionnaire was used to gather data from the respondents.

RESULTS AND DISCUSSION

The academic performance of the student's defense on the technology enhanced learning process.

Table 1. Level of Academic Performance in Mathematics during Pre-Test

| Academic Performance | (Controlled Group) | | (Experimental Group) | |
|----------------------|--------------------|--------|----------------------|--------|
| | Pre-test | Level | Pre-test | Level |
| Mean | 71.74 | Failed | 74.42 | Failed |
| Standard Deviation | 2.00 | | 3.47 | |

This implies that both experimental and controlled groups belong to the developing level or stage of academic performance during the pre-test, and the standard deviation shows the homogeneity of students' academic performance during the pre-test. This implies that the academic level of performance of the students during the pre-test has failed, which means that they are not ready for the next higher level of learning competency.

Table 2. Level of Academic Performance in Mathematics during Post Test

| Academic Performance | (Controlled Group) | | (Experimental Group) | |
|--------------------------|--------------------|---------|----------------------|---------|
| | Post-test | Remarks | Post-test | Remarks |
| Mean | 75.26 | passed | 80.46 | Fair |
| Difference from pre-test | 3.52 (increased) | | 6.04 (increased) | |
| Standard Deviation | 2.98 | | 3.28 | |

This implies that the post-test results increased significantly, and the experimental group results increased by 2.58 percent higher than the controlled group. This means that teaching using technologies enhanced the student's academic performance in mathematics. This signifies that teaching with the aid of technology is better than lecture-type or traditional teaching methods.

Table 3. Level of Academic Performance in Mathematics during the First Semester

| Academic Performance | (Controlled Group) | | (Experimental Group) | |
|----------------------|----------------------|---------|----------------------|-----------|
| | First semester Grade | Remarks | First Semester Grade | Remarks |
| Average | 83.51 | Good | 87.63 | Very good |
| Standard Deviation | 2.56 | | 2.66 | |

This implies that students who underwent teaching methods using technology performed better than those who used lecture-type methods in teaching math. This means that teaching using technology improved and enhanced students' academic performance. This signifies that technology-enhanced teaching strategies are better than lecture-type methods.

Table 4. Extent Effect to the Academic Level of Performance of the Respondents as Perceived by the Respondents Who Underwent Strategies Use of Technology (Such as Ipad, Apple TV) in Mathematics Class

| The Use of Technology (Such as iPad, Apple TV) in Mathematics Class | Experimental Group (Teaching using Technology) | | | Controlled Group (Lecture type of Teaching) | | |
|---|---|---------|------|--|-----------|------|
| | WX | Remarks | Rank | WX | Remarks | Rank |
| 1. With the use of technology, I am enjoying my math | 3.34 | O | 1.5 | 1.72 | NO | 8.5 |
| 4. I am motivated to use iPad to study mathematics. | 2.02 | NO | 13 | 1.69 | NO | 10 |
| 5. I am using technology in studying math at home. | 2.37 | NO | 11 | 2.38 | NO | 1 |
| 6. I am nervous in my math class if the teacher is using technology. | 1.39 | N | 16 | 2.13 | NO | 3.5 |
| 7. Using technology such as iPad in math is interesting. | 3.29 | O | 2.5 | 2.28 | NO | 2 |
| 9. I feel insecure if some of my classmates are using iPad in my math class. | 1.54 | NO | 15 | 1.67 | NO | 11 |
| 12. I am happy doing beyond the assigned work and solving more problems through iPad. | 2.80 | O | 8 | 1.82 | NO | 7 |
| 13. I have less work in math if there is technology. | 3.29 | O | 2.5 | 2.13 | NO | 3.5 |
| 14. Using an iPad, I am more comfortable in math. | 2.90 | O | 7 | 1.92 | NO | 6 |
| 16. I improve my math performance using technology | 2.66 | O | 10 | 2.03 | NO | 5 |
| General Wx | 2.52 | OFTEN | | 1.79 | NOT OFTEN | |

This implies that the use of technology has an extent effect on their academic performance as perceived by the students who underwent instruction using technologies. This signifies that technology helps them to learn and motivates them to study mathematics. This means technology-based instruction is better than lecture-type of instruction.

Table 5. Extent Effect on the Academic Level of Performance of the Respondents as Perceived by the Respondents Who Underwent Strategies as to Teaching Strategies

| Teaching Strategies | Experimental Group (Teaching using Technology) | | | Controlled Group (Lecture type of Teaching) | | |
|---|--|---------|------|---|---------|------|
| | WX | Remarks | Rank | WX | Remarks | Rank |
| 1. The teacher is using iPad and Apple TV successfully. | 3.73 | SE | 1 | 1.41 | NE | 8 |
| 2. The teacher integrates the iPad in his/her math class. | 3.14 | SME | 11.5 | 1.38 | NE | 9 |
| 3. The teacher searches or downloads the lessons in math and uses these in the classroom. | 3.24 | SME | 9 | 1.31 | NE | 10.5 |
| 4. The teacher is asking for help from the expert about using the iPad. | 2.02 | LE | 20 | 1.15 | NE | 17 |
| 5. The teacher is using USB if the iPad is not available. | 3.19 | SME | 10 | 1.26 | NE | 12.5 |
| 6. The teacher uses a chalkboard if the technology is not available. | 3.31 | SME | 7.5 | 3.21 | SME | 3.5 |
| 7. The teacher is subject-centered. | 2.04 | LE | 19 | 2.74 | SME | 5 |
| 8. The teacher uses the lecture method. | 2.09 | LE | 18 | 3.36 | SME | 2 |
| 9. The teacher attends the seminar and applies whatever he or she has learned. | 3.70 | SE | 2 | 3.21 | SME | 3.5 |
| 10. The teacher uses his/her iPad and lets the students experience using it too. | 3.53 | SE | 4 | 1.64 | LE | 7 |
| 11. The teacher explains the math lessons with the aid of technology. | 3.51 | SE | 5.5 | 1.26 | NE | 12.5 |
| 12. The teacher borrows many iPads and uses them in a group discussion. | 3.65 | SE | 3 | 1.31 | NE | 10.5 |
| 13. The teacher let his/her students bring and use their iPad in the classroom discussion. | 3.12 | SME | 13 | 1.21 | NE | 14.5 |
| 14. The teacher allows students to take pictures of the lessons using an iPhone, Mini pad, iPad, etc., instead of copying using a ballpen and notebook. | 2.53 | SME | 16 | 1.18 | NE | 16 |
| 15. The teacher asks the students to open their Facebook, Twitter, Instagram, or Edmodo accounts for their notes. | 2.65 | SME | 15 | 1.08 | NE | 19.5 |
| 16. The teacher discusses. She let | 2.34 | LE | 17 | 3.69 | SE | 1 |

her students answer on the board.

| | | | | | | |
|---|------|---------------|------|------|---------------|------|
| 17. The teacher encourages his/her students to search on the internet about their lessons | 3.09 | SME | 14 | 1.21 | NE | 14.5 |
| 18. The teacher evaluates students by technology intended to improve math performance. | 3.31 | SME | 7.5 | 1.08 | NE | 19.5 |
| 19. The teacher is student-centered. | 3.14 | SME | 11.5 | 2.41 | LE | 6 |
| 20. The teacher shows different videos to enhance students' skills in math. | 3.51 | SE | 5.5 | 1.10 | NE | 18 |
| General Wx | | SOME EVIDENCE | | | LESS EVIDENCE | |
| | 3.04 | | | 1.81 | | |

This implies that the extent level of academic performance is affected by the teachers' teaching strategies and varied use of technology. This means that instructions using technology are better than lecture-type methods. This signifies that technology plays a significant role in student's learning process and motivates them to learn more.

Table 6. Extent Effect on the Academic Level of Performance of the Respondents as Perceived by the Respondents Who Underwent Strategies as Teachers in Mathematics

| My teacher in mathematics: | Experimental Group (Teaching using Technology) | | | Controlled Group (Lecture type of Teaching) | | |
|---|--|---------|------|---|---------|------|
| | WX | Remarks | Rank | WX | Remarks | Rank |
| 1. Shows mastery of the subject. | 3.61 | SE | 6.5 | 3.26 | A | 5 |
| 2. Uses technology such as iPad, apple tv, etc. | 3.61 | SE | 6.5 | 1.10 | D | 17 |
| 3. Presents the lessons clearly and within the level of the learning. | 3.71 | SE | 3 | 3.44 | A | 3 |
| 4. Uses varied strategies | 3.63 | SE | 4.5 | 2.97 | A | 8.5 |
| 5. Arranges activities with increasing difficulty. | 3.63 | SE | 4.5 | 3.21 | A | 6 |
| 6. Gives the opportunity to participate in class discussion. | 3.39 | SE | 8 | 3.36 | A | 4 |
| 7. Willing to answer students' questions. | 3.76 | SE | 2 | 3.67 | SE | 1 |
| 8. Friendly to the students. | 3.80 | SE | 1 | 3.54 | SE | 2 |
| 9. Refuses to answer students' questions. | 1.83 | SD | 11 | 1.23 | D | 15 |
| 10. Gives praise whenever I answer correctly. | 3.22 | A | 9 | 3.03 | A | 7 |
| 11. Teaches fast. | 1.76 | SD | 12.5 | 1.77 | SD | 11 |
| 12. Explains how grades are arrived at. | 3.12 | SD | 10 | 2.97 | D | 8.5 |

| | | | | | | |
|---|------|-------|------|------|-------------------|------|
| 13.Scolds me from time to time when my answer is wrong. | 1.17 | D | 18 | 1.18 | D | 16 |
| 14.Does not return test papers on time. | 1.34 | D | 15 | 1.33 | D | 13 |
| 15.Ignore weak students. | 1.29 | D | 16 | 1.36 | D | 12 |
| 16.Plays favoritism in the class. | 1.27 | D | 17 | 1.28 | D | 14.5 |
| 17.Uses to call bright students. | 1.76 | SD | 12.5 | 1.95 | D | 10 |
| 18.Does not check assignments. | 1.41 | D | 14 | 1.28 | D | 14.5 |
| GENERAL wx | 2.63 | AGREE | | 2.33 | Slightly DISAGREE | |

This means that the teacher in math is effective as perceived by the students in both controlled and experimental groups. This implies that the teacher-student relationships are harmonious, and it helps the teaching-learning process of the students and the teacher in math is effective. And it also signifies that the teacher uses varied teaching strategies. The results show that using technology has an extended effect on students' level of academic performance.

Table 7. Comparison between the Student Levels of Academic Performance that Underwent Teaching Strategy Using Technology (Technological Instruction Method) and Lecture Type (Conventional/Traditional Instruction Method)

| Level of Academic Performance | F- Test | Degree of Freedom | F- Critical (0.05) | Decision | Remarks |
|-------------------------------|---------|-------------------|--------------------|--------------|-----------------|
| Pre-test | 0.0006 | 1/39 | 4.091 | HO: Accepted | No significance |
| Post-test | 5.687 | 1/39 | 4.091 | HO: Rejected | Significance |
| Final Grades in Math | 7.861 | 1/39 | 4.091 | HO: Rejected | Significance |

This implies that the academic performance before undergoing teaching strategies using Technology for the experimental group and lecture type for the control group did not differ. In contrast, the group level of academic performance in post-test and first grading grade in math did differ after undergoing teaching strategies using technology for the experimental group and lecture type for the controlled group. This means that their level of academic performance between groups varied differently. This signifies that using technology-enhanced student learning and effective strategies in teaching mathematics.

Table 8. Comparison between Difference between the Academic Performance during the Pre-Test, Post-Test, and Final Grades

| Academic performance during the pre-test, post-test, and Final grades | Chi-Square Test | Degree of Freedom | Critical Value At 0.05 | Decision | Remarks |
|--|------------------------|--------------------------|-------------------------------|-----------------|------------------------|
| | 8.034 | 2 | 5.99 | Ho: Rejected | Significant Difference |

This implies that the academic performance between the experimental and controlled groups did differ, and the academic performance in pre-test, post-test, and the entire duration of the first grading period also did differ. This signifies that the academic performance of the students who underwent teaching using technology and teaching using lecture type did differ. This means that technology has a significant role in enhancing the students learning in mathematics and helps improve.

CONCLUSIONS AND RECOMMENDATIONS

Teaching with the aid of technology is better than lecture-type or traditional teaching methods. Students who underwent teaching methods using technology performed better than those who used lecture-type methods in teaching math. Technology-based teaching strategies are better than lecture-type methods. The use of technology has an extended effect on their academic performance as perceived by the students who underwent instruction using technologies. Technology helps students to learn math better and motivates them to study mathematics. Technology-based instruction is better than lecture type of instruction. Technology plays a significant role in the student's learning process and motivates them to learn more. The teacher-student relationships are harmonious, and it helps the teaching-learning process of the students and the teacher in math is effective. Varied teaching strategies using technology have an extended effect on students' academic performance in mathematics. Using technology-enhanced student learning and effective strategies in teaching mathematics. The students quickly learned mathematics and understand better new lessons in math, and have the mature perception that math is not difficult and fun to learn with the aid of technology. The academic performance between the experimental and controlled groups did differ, and the academic performance in pre-test, post-test, and the entire duration of the first grading period also did differ. The academic performance of the students who underwent teaching using technology and teaching using lecture type did differ. Technology has a significant role in enhancing students learning in mathematics and helps improve their academic performance in mathematics.

Teaching mathematics with the aid of technology enhanced the student's level of academic performance, and they found mathematics to be fun to learn and straightforward, therefore, Teaching using technology and online learning is recommended for fast and accessible learning materials.

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