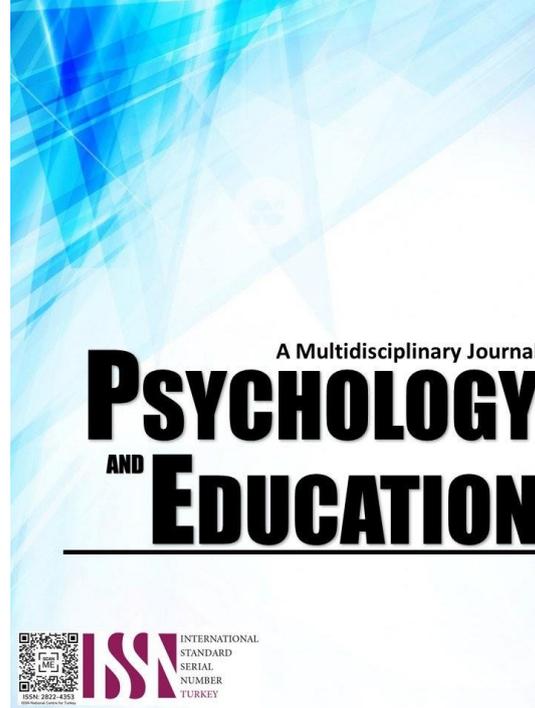


E-LEARNING MATERIALS: ITS USAGE AND EFFECTS IN LEARNING MATHEMATICS



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E-learning Materials: Its Usage and Effects in Learning Mathematics

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Abstract

During the pandemic, students faced greater challenges in learning mathematics. Due to the outbreak of the pandemic, many changes were made to the learning environment to adapt to changing conditions brought about by the new learning methods. These include the addition of new learning tools and techniques, as well as the training of teachers and students on how to use them. Since class interaction is limited, e-learning materials were used by the students to understand mathematical concepts. This study aims to determine the usage and effects of e-learning materials in learning mathematics among Bachelor of Secondary Education majoring in Mathematics during the COVID-19 pandemic. This study utilized descriptive-correlational research. Data were analyzed using mean, standard deviation, Pearson's r , and coefficient of determination. The respondents were randomly selected third year students. The e-learning materials were classified as printed, audio-visual, and specialized applications while mathematics performance is measured in terms of their final grades in Abstract Algebra, Calculus 3 and Problem Solving, Mathematical Investigation, and Modelling. The result of the study shows that printed and audio-visual e-learning materials affect the respondents' mathematical performance while specialized applications only bear significance with Calculus 3. The study shows the importance of being resourceful and fostering individual learning among students.

Keywords: *mathematics education, e-learning materials in mathematics, descriptive correlation, Oriental Mindoro Philippines*

Introduction

The COVID-19 pandemic struck the world in early 2020 (Cennimo D., 2022), affecting every industry, particularly those in the Philippines. Face-to-face or traditional methods of education give way to various modes of learning in the blink of an eye (modular and blended learning) in the blink of an eye. The abrupt change affects both teachers and students and harms student's performance. In mathematics, students demonstrated even smaller learning gains (Kuhfeld, M. et al., 2020). It is difficult for students to study without the teacher's guidance. Students struggle with communication and question-and-answer modes during virtual classes (Barrot, J. et al., 2021). They are also struggling financially. Aside from the internet load, several prior needs must be prioritized. Their greatest significant challenge was their home learning environment, which influenced their behavioral and emotional functioning, particularly attention and externalizing issues (Barrot, J. et al., 2021). Studying had become difficult for them because of the changes that had occurred.

With the shift from face-to-face instruction to other modes of learning, e-learning is becoming more popular in the teaching and learning process. E-learning is defined as web-based learning (Worton, 2015). It is used in a variety of contexts, including distance education, online education, and networked

learning. Students and teachers do not physically meet because they are separated by time, distance, or both. As a result, e-learning evolves directly from the application of virtual learning (Musbah and Mohammed, 2013). E-learning is facilitated electronically, it is carried out over the Internet, with students having access to their learning materials at any time and from any location.

Due to the outbreak of the pandemic, many changes were made to the learning environment to adapt to changing conditions brought about by the new learning method. These include the addition of new learning tools and methods, as well as the training of teachers and students on how to use them. Due to the complexity of the new learning method, many teachers had a hard time teaching. Students were able to grasp the lessons by using various e-learning materials such as soft copies, audio videos, and specialized applications, which Daniels et al. defined as computer-assisted learning as well as pedagogy for student-centered and collaborative learning.

Several groundbreaking studies have been conducted to assess the causal effects of course grade performance. These studies found that online training resulted in lower student performance than in-person instruction. Students who were less intellectually prepared fared the worst when it came to online learning (Cellini, 2021).

Methodology

Research Design

The purpose of this study is to learn about and comprehend the impact of e-learning on the performance of third-year BSED Mathematics majors at Mindoro State University – Bongabong Campus. Many research findings identified e-learning as a useful tool that improves student performance, but others disagree. E-learning may have an impact on students' performance, either positively or negatively. However, there has been very little research on the effects of e-learning on the performance of Mathematics major students, so this research was conducted.

During the COVID-19 pandemic, Abdel Jawad and Shalash (2020) investigated the effects of E-learning on students' academic achievement. According to their findings, when an e-learning strategy is implemented, students' academic performance differs statistically significantly, and most students struggle with blended learning.

Now, the primary goal of this study is to look at how e-learning affects the performance of third-year BSED Mathematics majors.

Research Questions

This study aimed to determine the effects of E-Learning on the performance of Third Year BSED students majoring in Mathematics at Mindoro State University-Bongabong Campus.

Specifically, this sought answers to the following questions:

1. What is the extent of utilization of e-learning materials in terms of:
 - 1.1 E-copies/ Soft copies;
 - 1.2 Audio-video; and
 - 1.3 Specialized Application?
2. What is the level of performance of the Third year Mathematics Major Students in terms of their final grades in:
 - 2.1 Abstract Algebra;
 - 2.2 Calculus 3; and
 - 2.3 Problem Solving, Mathematical Investigation, and Modeling?
3. Is there a significant relationship between e-learning materials and the level of performance of the students?

The present study employed the descriptive-correlational research method to identify the effects of e-learning on the levels of performance of the students. According to Ozer et al. (2022), descriptive research focuses on describing the phenomenon in detail as they are in nature and involves collecting data to test the hypothesis or to answer questions concerning the status of the subject of the study. It was used in the study to determine the extent of utilization of e-learning materials in terms of e-copies, audio-video and specialized applications. However, according to Creswell (2012), the correlational research method measures the degree of relationship between variables. This research method was implied in this study to identify the variables if there is a significant relationship between the extent of the utilization of e-learning materials and the level of performance of the students on their subjects.

Research Locale. The study was conducted at Mindoro State University (MinSU)Bongabong Campus, which is in Barangay. Labasan, Bongabong, Oriental Mindoro. The school offers different colleges including the College of Teacher Education. The College of Teacher Education at Mindoro State University Bongabong Campus has a population of 327 which consists of Bachelor of Elementary Education and Bachelor of Secondary Education with three majors: English, Mathematics, and Science.

Population, Sample and Sampling Technique. The study involves the Bachelor of Secondary Education majoring in Mathematics third year students. Out of 32 students, only 24 of them were utilized as respondents to the study. Simple random sampling method to select the respondents.

Research Instrument

In this study, a self-made questionnaire was used as the primary instrument in gathering the necessary data. The questionnaire is composed of three parts, the first part is intended to measure the extent of utilization of e-learning in terms of e-copy/soft copy materials; the second part is for audio-video materials; and the last part is for specialized applications. Each part is measured by a 4-point Likert Scale.

The researchers used Google Forms to employ the questions, and the link was sent to the respondents through Messenger. By that, the researchers ensured the safety of the involved people. Before that, the



researcher collected the grades of the respondents in their primary subject from the registrar’s office.

Data Gathering Procedure

The data needed in the study were gathered through respondents' answers to the given questionnaires and their grades on the significant courses provided by their instructors. The questionnaires were distributed with the permission of the school authorities to the students of Third Year BSED Mathematics Major at MinSU Bongabong Campus using Google Form; 24 students were the target respondents. After the allotted time, the form will be retrieved and sorted out. At the same time, the grades were obtained through formal request letters to the registrar.

Data Analysis

The data gathered was tabulated and interpreted using descriptive statistics such as mean, frequency count, and percentage. These tools were used to determine the extent of utilization of e-learning materials in terms of e-copies/soft copies, audio-video, and specialized applications as well as the grades of the respondents. Further, Pearson's r Correlation was utilized to determine the relationship between the variables.

Results and Discussion

The extent of utilization of e-learning materials in terms of:

E-copies

In table 1, the highest mean score of 3.54, indicates that students always understand the lesson well with the help of e-copy materials. However, the lowest mean score of 2.83 shows that students can seldom easily follow the solution process using e-copies. The overall mean score of the result was 3.24, which indicates that students seldom utilize e-copy as a medium of their learning.

The result implies that from time to time, most students use e-copy materials as a basis of their learning because they can learn at their own pace and that is supported by Ambayon (2020) who said that modular instruction is more operative in the teaching-learning method as equated to usual teaching approaches because in this approach the students learn in their own pace.

Table 1. *Extent of utilization of E-learning Materials in terms of E-copies*

Item	Mean	Rank	Description
1. E-copy materials help me understand the lesson well.	3.54	1	Always
2. I prefer to study and review through e-copies.	3.46	2	Seldom
3. I can easily follow the solution process in the e-copy.	2.83	5	Seldom
4. I often rely solely on e-copies whenever solving problems is not included.	3.21	3	Seldom
5. I prefer to use e-copies than any other learning materials.	3.17	4	Seldom
Overall Mean	3.24		Seldom

Audio-Video

Table 2 presents the utilization of audio-video materials wherein the students always love to watch videos/tutorials to understand the lesson as shown by the highest mean score of 3.58. However, the lowest mean score of 3.13 shows that students seldom watch videos to clarify and check the content of previous lessons. The overall mean score of the result was 3.35, which indicates that students seldom utilize audio-video as a medium of their learning. This implies that students use audio-video materials to help them remember what they have seen/watched. As to what the study conducted by Shamsideen (2016) stated, audio-visual materials are important in the teaching-learning process because having seen something, most people remember, whatever that thing was, it conjures up an image at a mere mention and can be talked about freely.

Table 2. *Extent of utilization of e-learning Materials in terms of Audio-Video Materials*

Item	Mean	Rank	Description
1. I love to watch videos/tutorials to understand the lesson.	3.58	1	Always
2. I prefer to study using audio-visual materials.	3.33	3	Seldom
3. I allot time to watch videos and tutorials connected to the topics of my Major Subjects.	3.42	2	Seldom
4. I only watch videos to clarify and check the content of previous lessons.	3.13	5	Seldom
5. I utilize what I learned in tutorials/videos I've watched to answer assessments and quizzes.	3.29	4	Seldom
Overall Mean	3.35		Seldom

Specialized Applications

The respondents seldom use specialized applications to solve hard math problems which ranked first with the highest mean score of 2.53 as indicated in Table 3. Conversely, the respondents rarely use the solutions on



specialized applications in answering their assignments and activities ranked last with the lowest mean score of 2.21. The overall mean score of the result was 2.37, which indicates that students rarely utilize specialized applications as a medium of their learning. The result implies that most of the students rarely use specialized applications due to a lack of knowledge about using such applications. The findings of Drigas (2015) showed that researchers developed online and mobile applications to support teaching in Algebra, Geometry, Mathematical Analysis, Statistics, and other areas of Mathematics. Mobile Mathematics applications allow users to explore functions, provide graphical capabilities, and offer many kinds of specific calculators. However, due to a lack of orientation and proper explanation of how specialized applications are used, students are not fond of using such applications.

Table 3. *Extent of utilization of e-learning Materials in terms of Specialized Application*

Item	Mean	Rank	Description
1. I use specialized applications (e.g., PhotoMath, Mathway, etc.) in solving problems.	2.38	3	Rarely
2. I prefer to use specialized applications to solve hard math problems in my major subjects.	2.53	1	Seldom
3. Whenever I find it hard to solve problems, I use the solutions on specialized applications in answering my assignments and activities	2.21	5	Rarely
4. I use specialized applications when I am not convinced with my attained answer.	2.29	4	Rarely
5. I apply specialized applications to my 3 major subjects to check solutions and answers in every activity, quiz, or assignment.	2.42	2	Rarely
Overall Mean	2.37		Rarely

The level of performance

Abstract Algebra

It could be gleaned from Table 4 that all students (100%) have an outstanding level of performance on the course because they gain a mean score of 92. The result implies that respondents show excellent performance because they can understand the lesson well when they learn at their own pace and time. The result supports the study of Buan et al. (2016), that online learning allows a more student-centered teaching approach. Because every student has his or her way of learning that works for him or her, getting an online education may help in ensuring that each

lesson or material is completely understood before moving on to the next, which in turn could result in better learning.

Table 4. *Performance in Abstract Algebra*

Scale	Frequency	Percentage	Description
90-100	24	100%	Outstanding
85-89	0	0%	Very Satisfactory
80-84	0	0%	Satisfactory
75-79	0	0%	Fairly Satisfactory
Below 75	0	0%	Did not meet expectations
Total	24	100%	
Mean		92	Outstanding

Calculus 3

Table 5 shows that there are 2 out of 24 (8%) who got the highest level of performance in the subject, while 3 out of 24 (13%) got the lowest level of performance. The overall mean score is 83.96 which indicates that most students have a level of satisfactory performance on the subject, Calculus 3. This implies that the respondents were able to meet the standards of the subject through online learning. The result agrees with the findings of the study by Dirgantoro (2021) that online learning makes students unable to ask peers directly as they are having difficulties. Students are also unable to ask directly when there is an explanation from the lecturer on video footage that is poorly understood, resulting in the students to fairly satisfying the standards required on the subject they are taking.

Table 5. *Performance in Calculus 3*

Scale	Frequency	Percentage	Description
90-100	2	8%	Outstanding
85-89	6	25%	Very Satisfactory
80-84	13	54%	Satisfactory
75-79	3	13%	Fairly Satisfactory
Below 75	0	0%	Did not meet expectations
Total	24	100%	
Mean		84	Satisfactory

Problem Solving, Mathematical Investigation, and Modelling

In table 6, 23 out of 24 (96%) students exemplify outstanding performance on the subject, while 1 out of 24 (4%) students was very satisfactory. The mean score is 93.46 which indicates that most students have an outstanding level of performance in the subject. This denotes that more students are skilled and have



sufficient knowledge and performance on the subject because they were able to assess their ability to solve mathematical problems through online learning. The findings corroborate the result of the study of Marhami et al. (2021), that during the Covid-19 pandemic, the student’s ability to solve mathematical problems through online learning was satisfactory. The findings showed that learning arithmetic problem-solving skills online was beneficial during the Covid-19 pandemic.

Table 6. *Performance in Problem Solving, Mathematical Investigation, and Modelling*

Scale	Frequency	Percentage	Description
90-100	23	96%	Outstanding
85-89	1	4%	Very Satisfactory
80-84	0	0%	Satisfactory
75-79	0	0%	Fairly Satisfactory
Below 75	0	0%	Did not meet expectations
Total	24	100%	
Mean		93	Outstanding

Relationship between the extent of utilization of E-learning Materials and the Level of Performance of the Students

Table 7 shows the correlation between the variables under study. As presented, there is a significant relationship between the utilization of e-copies of learning materials and the performance in Abstract Algebra ($r = 0.52$), Calculus 3 ($r = 0.44$), and Problem Solving, Mathematical Investigation and Modelling ($r = 0.54$). This implies that the use of e-copies of learning materials positively affects the mathematics performance of the students during the pandemic. This aligns with the findings of Ambayon (2020) that modular instruction is more operative in the teaching-learning method as equated to usual teaching approaches because in this approach the students learn at their own pace.

A significant relationship was also found between the utilization of audio-video learning materials and the performance in Abstract Algebra ($r = 0.51$), Calculus 3 (0.47), and Problem Solving, Mathematical Investigation and Modelling ($r = 0.53$). This denotes that the use of audio-video has a direct effect on the mathematics performance of the respondents in their major courses. The result agrees with the findings of Shamsideen (2016) that audio-visual materials make the teaching-learning process more meaningful.

However, there is no significant relationship between the utilization of specialized applications such as e-

learning materials and the performance in Abstract Algebra ($r = 0.37$), and Problem Solving, Mathematical Investigation, and Modelling ($r = 0.22$). This implies that using specialized applications could not predict math performance. This could be attributed to the fact that these two courses require skills that could not be learned through specialized applications. This was parallel with the results of the study of Jawad and Shalash (2020) that when an e-learning strategy is implemented, students' academic performance differs statistically significantly, and most students struggle with blended learning.

A significant relationship exists between the utilization of specialized applications as e-learning materials and the performance in Calculus 3 ($r = 0.40$). This implies that specialized applications help improve the level of performance of the students in the subject. This supports the findings of Drigas (2015) which concluded that Mathematics applications allow users to explore functions, provide graphical capabilities, and offer many kinds of specific calculators.

Table 7. *Correlation result between the Respondents’ Extent of Utilization of E-learning Materials and Level of Performance*

Conclusion

IV: Utilization of E-Learning Materials	DV: Performance in Major Subjects					
	Abstract Algebra		Calculus 3		Problem Solving	
	r-value	result	r-value	result	r-value	result
E-Copy	0.52	Significant	0.44	Significant	0.54	Significant
Audio-Video	0.51	Significant	0.47	Significant	0.43	Significant
Specialized		Not		Not		Not
Application	0.37	Significant	0.41	Significant	0.22	Significant

This study is conducted to look for the effects of e-learning materials on the level of performance of the students taking BSED Major in Mathematics at Mindoro State University-Bongabong Campus. The researchers conclude that the extent of utilization of e-learning materials in terms of e-copies, audio-video materials and specialized applications shows that it was used occasionally by the students and the level of performance of the students shows that there is a very satisfactory level of performance on their major courses. Based on the findings there is a significant relationship between the extent of utilization of E-learning materials and the level of performance of the students in their major subject.

The researchers recommend that e-learning materials should be utilized to enhance the performance of the students for them to learn at their own pace and let them explore and use their preferred medium/learning

materials. In terms of materials, facilitators should introduce different types of e-learning materials that will enable the students to learn something new. Through this, students may develop and master basic skills in using different types of e-learning materials.

References

- Abdel Jawad, Y. A. L., & Shalash, B. (2020). The impact of e-learning strategy on students' academic achievement. Case Study: Al- Quds Open University. *International Journal of Higher Education*, 9(6), 44. <https://doi.org/10.5430/ijhe.v9n6p44>
- Andaya, O. (2014). Factors that Affect Mathematics Achievements of Students of Philippine Normal University – Isabela Campus. *Journal of Arts, Science & Commerce*
- Ambayon, C. (2020). Modular-Based Approach and Students achievement in literature. *International Journal of Education & Literacy Studies* 8(3):32-36
- A-booki, P.N., & Kitawi, A.K., (2014). Impact of E-Learning Strategy on Students' Academic Performance at Strathmore University, Kenya. *Makerere Journal of Higher Education. Journal of Educational Technology in Higher Education*. Article 32
- Barrot, J. et al., (2021). Students' online learning challenges during the pandemic and how they cope with them: The case of the Philippines. *Education and Information Technologies*
- Bringula, R. (2021). Mathematics Self-Concept and Challenges of Learners In An Online Learning Environment During COVID-19 Pandemic. *Smart Learning Environments*. Article 22
- Buan, A. et al., (2016). Effectiveness of Developed Online-Classroom in Mathematical Investigation and Modelling.
- Cellini, S. R. (2021, August 13). How does virtual learning impact students in higher education? *Brookings*. <https://www.brookings.edu/blog/brown-center-chalkboard/2021/08/13/how-does-virtual-learning-impact-students-in-higher-education/>
- Cennimo, D. MD. et al., (2022). Coronavirus Disease 2019 (COVID-19)
- Dalhberg (2012). *The Theory and Practice of Online Learning*. AU Press, Athabasca University.
- Daniels, MM. et al, (2019). Students' perception on e-learning: A basis for the development of e-learning framework in higher education institutions. *The International Conference Information Technology and Digital Applications*.
- Dellisola, E. & DeCaro, F. *Scaffolding Theory*. <https://www.sutori.com/en/story/scaffolding-theory--7V59zkWLaSuFHeRG2WY2MJ4W>
- Dirgantoro, K., and Soesanto. R. (2021). The Impact of Pandemic Dynamics in Differential Calculus Course: An Overview of Students' Self-Regulated Learning Based on Motivation. <https://doi.org/10.2991/assehr.k.210508.043>.
- Drigas, A., and Pappas, M. (2015). A Review of Mobile Learning Applications for Mathematics. Vol 9, https://dx.doi.org/10.3991/ijim.v9i3.4420%20https://www.researchgate.net/publication/280645657_A_Review_of_Mobile_Learning_Applications_for_Mathematics/link/55c0b4de08ae9289a09b9cd1/download
- Insorio, A. et al, (2022). Video Lessons via YouTube Channel as Mathematics Interventions in Modular Distance Learning. *Contemporary Mathematics and Science Education*, 3(1), ep22001
- Islam, N., Beer, M., & Slack, F. (2015). E-Learning Challenges Faced by Academics in Higher Education: A Literature Review. *Journal of Education and Training Studies*, 3(5). <https://doi.org/10.11114/jets.v3i5.947>
- June S., Yaacob A., Kheng Y. (2014). Assessing the Use of YouTube Videos and Interactive Activities as a Critical Thinking Stimulator for Teaching Students: An Action Research. *International Education Studies* 7(8): 56-67
- Khadija A. et al., (2020). Covid-19 and eLearning: Perceptions and Attitudes of Teachers towards ELearning Acceptance in Developing Countries. Volume 6, Issue 2
- Kuhfeld, M. et al., (2020). How is COVID-19 affecting student learning?
- Mansureh, K., Angie, L., and Lilia, S. (2017). Issues and Challenges for Teaching Successful Online Courses in Higher Education. *Journal of Educational Technology Systems*, Vol. 46(1) 4-29, pp. 11-14. DOI: 10.1177/0047239516661713.
- Marhami, M., Fonna, M., Mursalin, M., & Nuraina, N. (2020). The Effect of Video Conference Assisted Online Learning on Students' Mathematical Problem-Solving Ability during the Covid-19 Pandemic. *International Journal for Educational and Vocational Studies*, 2(11). <https://doi.org/10.29103/ijevs.v2i11.3317>
- Musbah et al. (2013). The Effect of E-learning on teaching and Learning of Mathematical Concepts
- Ryan et al. (2016). The effectiveness of blended online learning courses at the community college level. *Community Journal of Research and practice* 40(4):1-14.
- Shamsideen, S. (2016). Impact of Audio-Visual Materials in the dissemination of knowledge for facilitators in some selected literacy centers in Oshodi/Isoli Local Government Area. *African Education Research Journal*. Vol.4(1),19-24
- Spitzer, M. W. H., & Musslick, S. (2021). Academic performance of K-12 students in an online learning environment for mathematics increased during the shutdown of schools in wake of the COVID-19 pandemic. *PLOS ONE*, 16(8), e0255629. <https://doi.org/10.1371/journal.pone.0255629>
- Thomas, L. (2020). Simple random sampling. <https://www.scribbr.com/methodology/simple-random-sampling/>
- Worton, H. (2015). A study into the effects of e-learning on higher education. *Journal of University Teaching & Learning Practice*. Vo. 2(1)



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