Embracing Digital Technologies into Mathematics Education

Analyn M. Gamit[1,*]

[1]Nueva Ecija University of Science and Technology, Philippines

*Correspondence: Nueva Ecija University of Science and Technology, Philippines

Received: January 15, 2023 Accepted: January 28, 2023 Online Published: February 16, 2023

doi:10.5430/jct.v12n1p283 URL: https://doi.org/10.5430/jct.v12n1p283

Abstract

It might be challenging to find a way to incorporate digital technology into the classroom successfully. The purpose of this research was to document the implementation of a digital tool into three high school mathematics classrooms to enhance teacher and student learning. The researcher used the Learning Management System (LMS) as an educational online integrated software to looked at educators' perspectives on its value and how they are putting their newfound knowledge to use in the classroom, as well as their reasons for using LMS resources and determine how teachers plan to use new technological tools in their classrooms. Using surveys and classroom observations, the researcher found that a poorly established social artifact was the most significant barrier to students' education. When teachers do not try to develop standard procedures for utilizing technology, students often struggle to use the instrument well. Teachers can only possibly assist their pupils in integrating teacher and agent instructions when they grasp how the tool works for themselves. Instead of having one cohesive learning experience, students are kept from their teachers and devices.

Keywords: mathematics, education, digital education, technology, online class, integration

1. Introduction

1.1 Introduce the Problem

The Department of Education (DepEd) in the Philippines has adopted a Learning Management System (LMS) as part of its efforts to improve and modernize the education system in the country. An LMS is a software application or platform used to plan, deliver, manage, and evaluate educational content and resources. DepEd has adopted the use of a web-based LMS called the DepEd Commons, which is aimed at providing teachers, students, and parents with access to quality educational resources, as well as a platform for collaboration and communication. The DepEd Commons offers features such as online content delivery, assessment, and tracking and allows for integration with other learning tools and resources. The adoption of the LMS by DepEd is part of the Philippine government's larger efforts to promote technology-enhanced learning and to support the development of 21st-century skills among students. The use of the LMS is expected to improve the efficiency and effectiveness of education delivery, as well as provide students with access to a wider range of learning resources and opportunities. ("DepEd Learning Management System and Electronic Self-learning Modules," 2020)

The question of how to successfully incorporate digital technology into teaching and learning practices has taken on greater importance as the rate of digitalization in education systems around the world accelerates in the wake of legislation and action plans issued by many nations to hasten the process. Much of the study in this area has focused on the outcomes and operations of digitization in educational institutions. While research on digitalization efforts has been conducted in several nations, more is needed to know how best to use information and communication technology (ICTs) in the classroom to bolster instruction and enhance students' learning environments. Academics have often demanded more data to fully grasp the nuanced nature of technological innovation and change in the service of better education (Howard et al., 2017).

This research intends to further that comprehension by investigating the use of a cutting-edge ICT tool to study mathematics in Philippine primary and secondary schools.

There are two reasons why it makes sense to prioritize math instruction. Research has shown that math educators are the least likely to utilize digital resources in the classroom. Math is an essential course, but many students need help

with it. Knowing whether or not digital technologies might aid in improving learning outcomes and providing appropriate learner support is crucial. Second, it has been argued that the use of technological tools in the classroom, when combined with good pedagogy, can help students acquire transferable skills like critical thought processes and problem-solving and solve problems that are all too common in the field of mathematics teaching and learning, such as "the ability to accommodate realistic, problem-solving and collaborative strategies to teaching and learning."

Digital technology has the ability to assist teachers in improving the study and teaching of mathematics elsewhere. Students' mathematical performance has transformed due to their increased mathematical exposure (Cahyono & Ludwig, 2018). Teachers' greater use of digital materials will create a fresh experience for students learning mathematics, such as guaranteeing students are not bored (Wijaya et al., 2022). Experts in the field to aid mathematics instruction for decades have emphasized the potential of information and communication technologies in conjunction with sound pedagogy. However, a recent assessment of empirical studies on the use of digital technology in mathematics education emphasizes that technology usage "does not, in the main, live up to their projected promise to revolutionize the learning experience" (Bray & Tangney, 2017). Students (creative) usage of digital technology is less common at school than in other contexts. Most of the time, these tools are employed to supplement more conventional teaching methods (Borba et al., 2017). Because of this, further research on how digital technologies have been incorporated into mathematics education and the effects of doing so is necessary.

In this research, "integration" of technology means incorporating it to enhance the operation of a complex data system, such as using ICTs both in and out of the school. Several dynamic variables are also connected to integration, such as efficient methods, the technical features of new instruments, the ability to revamp the educational system altogether, and the possibility of introducing entirely novel approaches to instructing and learning. To tackle this issue, we've decided to analyze educational technology using the Structurational Practicing Lens and the Information Management Artifact. (Bray & Tangney, 2017).

There has been a rise in academics' and practitioners' interest in how digital technologies, especially mobile ones, might improve mathematics instruction (Borba et al., 2017). Recent research has emphasized the opportunities, challenges, and barriers associated with using technology in mathematics education. Bray and Tangney reviewed empirical studies examining the use of digital technology in teaching mathematics and found that most interventions (61% of the articles in the sample) were classed as augmentation (Donnelly et al., 2011). This indicates that technology was utilized to improve traditional methods by adding new functions or ways of thinking about them and outsourcing data distribution. Attempts to employ technology to enhance mathematics education have run into several snags.

The role of the teacher is evolving from one of lecturer to that of facilitator, and there is a growing recognition of the need for a systematic, evidence-based approach to teaching. Scholars believe that to transform education on a fundamental level, teachers need access to cutting-edge methods of instruction, relevant examples, collaborative learning environments, and administrative and professional backing (Donnelly et al., 2011). Several authors have argued that it is crucial to include technology in classrooms (Denoél et al., 2017). An analysis of tablet technology's involvement in mathematics education finds that teachers confront obstacles when attempting to construct sessions that are both technologically novel and pedagogically sound (Svela et al., 2019). Several aspects are associated with the implementation of technology into mathematics education. These factors include the design of the technologies, educational assignments and activities, the role of the instructor, and the educational setting (*2nd Survey of Schools: ICT in Education*, 2017).

Promoting organizational commitment among teachers is crucial since they are dedicated to working more and staying longer (Santos, 2020). The teacher takes on the role of a conductor, guiding students through the learning process by synthesizing their work from technology-heavy activities, guiding them toward more effective use of the tool, and establishing links between their digital and analog mathematical attempts. Mathematics teachers need to be engaged as co-designers and teacher-researchers if digital technologies are used to change mathematical practice (Halperin, 2017). Nonetheless, this design procedure is challenging because it necessitates the examination of (i) the dialectical effect of tools on mathematical models and transmission and (ii) the several design and analysis focuses. In most cases, students will need help to use technology effectively to improve their education (Nh, W., & Nicholas, H. 2013). Teaching methods that are successful and can be maintained over time can only be developed via student and teacher cooperation. Educators must increase their technological fluency and topic knowledge as part of this endeavor. Finally, it is crucial to integrate digital resources into a coherent pedagogical design.

2. Method

A total of 70 teachers participated in learning management system (LMS) training during the project's duration, and their responses were utilized in the large-grain size study. After receiving training, many teams of educators were planning to or had already deployed the interactive STEM tools. The focus group of educators was utilized for collecting and analyzing fine-grain size data and their responses to a questionnaire developed for the project, piloted by the research team, and then executed with the focus group. Teachers were given a survey to fill out before and after completing the program, including professional training sessions. These questionnaires were administered to the following groups:

Group 1: Teachers were invited to complete the survey after attending an LMS training session but before using the STEM materials in their classrooms.

Group 2: After beginning to use STEM materials in the classroom, teachers were invited to fill out this survey.

Group 3: Teachers were invited to complete a questionnaire after completing lessons with their students utilizing the STEM materials.

By conducting this survey, the researcher would better understand teachers' past knowledge and current comfort levels with various aspects of educational technology usage and the devices and resources teachers were utilizing in their classes before and after the training. The researcher also looked at educators' perspectives on the value of LMS training and how they're putting their newfound knowledge to use in the classroom, as well as their reasons for using LMS resources, how much they've used them, and how much they plan to use them in the future. The study was also designed to determine how teachers plan to use new technological tools in their classrooms. Teachers were polled on their impressions of LMS, the project's professional development training, and the incorporation of STEM equipment (including computers and mobile devices) into their lessons.

Math Aid is utilized throughout the study process as well. The purpose of the Math Aid program, browser-based software that students may access from their mobile devices, is to support students in their mathematical studies inside and outside the classroom. It may be used in tandem with the standard high school mathematics textbooks or as a supplemental tool for teachers. Math Aid’s theoretical portion introduces students to the selected mathematical theories. At the same time, the practical section provides real-world examples of the phenomena being studied, learning exercises with answers, and helpful recommendations to guide students through the solution of selected assignments. Teachers may utilize Math Aid’s built-in monitoring capabilities to maintain tabs on pupils' usage of the program individually and collectively. Math Aid’s self-instructional and interactive learning assignments, such as calculation steps, explanations, and moving graphs that depict mathematics, are available on any computer, laptop, smartphone, or tablet running iOS or Android.

3. Results

According to the results, presenting LMS materials in the classroom through projection is preferable to having students use school-issued devices to access the same materials. Teachers, however, have seen that many students have their own devices that may be used in and out of school. This study concerning the potential of technology resources is fascinating because of the growing prevalence of such access in the home and the school. A novel lens may be thrown on integrating technology in the classroom through using LMS on students' devices in the absence of computer labs or laptops. In recent research, the researcher examined why teachers must move away from relying only on technology presentations to encouraging students' technology use in the classroom.

Researchers are following up with teachers after they have finished the questionnaires and the experiment to see whether and how they use students' personal devices in the classroom, for homework, and in flipped learning activities. In subsequent publications, these issues will get further attention. The researcher surveyed teachers to find out their tech-readiness before commencing LMS training. Math educators and researchers are interested in exploring how mobile technology (including smartphones and tablets) may enhance the discipline. Mobile devices are becoming a formidable agent with the potential to expand mathematics education beyond the confines of the traditional classroom due to their mobility, accessibility, Internet connection, and broad appeal among young people and others.

4. Discussion

The results of this study, which set out to investigate the use of technology in mathematics education, suggest that such implementation could be better. Students are usually allowed to discover the features and benefits of MathAid

independently. Many students need help meeting its demands and learning to use it to boost their academic achievement effectively.

Since research has shown the value of integration, this is cause for alarm. Research suggests that the impact of technology on student performance may be anywhere from a 12% improvement to a 16% decline, based on PISA data. Reading growth in elementary schools, children whose usage of technology was appropriately integrated with the curriculum performed around 20% better than those who did not utilize technology. A third group performed even worse than the no-tech control group because they needed a methodical approach to using technology (Genlott & Grönlund, 2016). According to the findings of this study, teachers overestimate their students' proficiency with digital tools. Educators had hoped that students would quickly grasp Math Aid's fundamentals on their own, but over a year in, many were still perplexed.

To get the most out of a math program, you need both technical knowledge and mathematical competence. It's only standard for teachers to know more about math and education than their students do. Educators did provide advice on how to make the most of the tools at their disposal. The idea that technology might aid pupils with their homework and act as a replacement teacher was vital. By doing so, educators would have more time to work with students individually and in small groups, while students might put to good use their time outside of class for practice. Though some students could use the app's functionalities successfully, most still needed to. Teachers didn't monitor students' use of electronic gadgets since they didn't see it as a problem. Many people's answers were yes.

The takeaway message is clear: teachers need to make lessons on diversity and acceptance a top priority. To succeed in your role, you must accept the fact that it is up to you to develop and implement efficient processes. While giving students access to these tools to complete assignments is a fantastic concept, it will only be successful if teachers use the resources themselves. When one teacher emphasizes the importance of students taking ownership of their work, that teacher cannot simply leave behind those kids who require more support to follow through. Helping students requires thinking of manageable but meaningful activities to complete, monitoring their progress, and adjusting accordingly. MathAid's built-in monitoring features allow teachers to maintain tabs on their students' development and identify areas of strength and weakness. Using the tool in tandem with teacher comments on student work may help students refine their processes. By getting started with the app's features and resources as early as possible, children will have more time to establish effective habits and create the framework for future mathematics learning. This might add more work for teachers. Therefore, it's crucial to consider how the software and its provider can help with the extra work.

5. Conclusion

Despite the importance of technical skills (the results suggest that students are less proficient in digital media than their teachers would assume), the research found that students placed a higher value on content knowledge and interpersonal connections. Teachers should make significant efforts to incorporate technology into their lessons and to provide spaces for encouraging collaborative learning and practice. What I mean by this is mostly but not only.

1. Matching the material of lectures, assignments, and examinations to prevent pupils from striving to grasp how multiple sources fit together.
2. Providing an early and thorough introduction to digital tools and a clear explanation of how to utilize them technically and in terms of how to approach the subject matter.
3. Monitoring student technology usage and intervening to bring them on track.
4. Arrange classes so students and teachers can work together and learn from one another.

The findings suggest that schools and teachers alike need to dedicate substantial time and energy to mastering the tools' functions, meticulously developing learning circumstances, and paying great attention to the finer aspects when putting those plans into action in the classroom if they want to incorporate digital tools into mathematics teaching effectively. The key to success is using technology to facilitate knowledge sharing, differentiation, and contextualization among students.

Acknowledgments

The researcher would like to express her sincere gratitude to her family and friends for their help and support in making this study successful.

References

2nd Survey of Schools: ICT in Education. (2017, July 25). Shaping Europe's Digital Future. Retrieved from https://digital-strategy.ec.europa.eu/en/library/2nd-survey-schools-ict-education

Agelíi Genlott, A., & Grönlund, Å. (2016). Closing the gaps: Improving literacy and mathematics by ICT-enhanced collaboration. *Computers & Education, 99*, 68-80. https://doi.org/10.1016/j.compedu.2016.04.004

Borba, M., Askar, P., Engelbrecht, J., Gadanidi, G., Llinares, S., & Aguila, M. (2017). Digital technology in mathematics education: Research over the last decade. In G. Kaiser (Ed.), *Proceedings of the 13th International congress on mathematical education. ICME-13 monographs* (pp. 221-233). Retrieved from https://library.oapen.org/bitstream/handle/20.500.12657/27742/1002263.pdf?sequenc#page=229

Bray, A., & Tangney, B. (2017). Technology usage in mathematics education research: A systematic review of recent trends. *Computers & Education, 114*, 255-273. https://doi.org/10.1016/j.compedu.2017.07.004

Cahyono, A. N., & Ludwig, M. (2018). Teaching and learning mathematics around the city supported by the use of digital technology. *Eurasia Journal of Mathematics, Science and Technology Education, 15*(1), em1654.

Denoél, E., Dorn, E., Goodman, A., Hiltunen, J., Krawitz, M., & Mourshed, M. (2017). Drivers of student performance: Insights from Europe. 2019-10-19. Retrieved from https://www.mckinsey.com/industries/social-sector/our-insights/drivers-of-student-performance-insights-from-europe

DepEd Learning Management System and Electronic Self-learning Modules. (2020). Retrieved from https://authdocs.deped.gov.ph/wp-content/uploads/2021/09/FINAL-20-DepEd-LMS-and-E-SLMs-0921038-20210903.pdf

Donnelly, D., McGarr, O., & O'Reilly, J. (2011). A Framework for teachers' integration of ICT into their classroom practice. *Computers & Education, 57*(2), 1469-1483. https://doi.org/10.1016/j.compedu.2011.02.014

Halperin, R. (2017). Learning practice and technology: Extending the structuration practice lens to educational technology research. *Learning, Media and Technology, 42*(3), 279-294. https://doi.org/10.1080/17439884.2016.1182925

Howard, S., Thompson, K., Yang, J., & Ma, J. (2019). Working the system: Developing a system model of technology integration to inform learning task design. *British Journal of Educational Technology, 50*(1), 326-341. https://bera-journals.onlinelibrary.wiley.com/doi/10.1111/bjet.12560

Lee, A., Thomas, M., & Baskerville, R. (2015). Going back to basics in design science: From the information technology artifact to the information systems artifact. *Information Systems Journal, 25*(1), 5-21. https://doi.org/10.1111/isj.12054

Nh, W., & Nicholas, H. (2013). A framework for sustainable mobile learning in schools. *British Journal of Educational Technology, 44*(5), 695-715. https://doi.org/10.1111/j.1467-8535.2012.01359.x

Santos, A. R. (2020). Organizational commitment of instructors of private colleges in Nueva Ecija. *International Journal of Humanities and Education Development (IJHED), 2*(1), 57-60.

Svela, A., Nouri, J., Viberg, O., & Zhang, L. (2019). A systematic review of tablet technology in mathematics education. *International Journal of Interactive Mobile Technologies (iJIM), 13*(8), 139-158. https://doi.org/10.3991/ijim.v13i08.10795

Wijaya, T. T., Zhou, Y., Houghton, T., Weinhandl, R., Lavicza, Z., & Yusop, F. D. (2022). Factors affecting the use of digital mathematics textbooks in indonesia. *Mathematics, 10*(11), 1808.

Copyrights