



Exploring the role of math applications in preservice teachers' learning: a narrative inquiry

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ABSTRACT

This study employs a narrative qualitative design to explore the role of math applications in the learning journeys of preservice mathematics teachers. Data were gathered through interviews with 15 preservice teachers in La Union. Findings revealed the use of GeoGebra, Photomath, Gauthmath, Mathway, and Khan Academy to enhance conceptual understanding through visualization, simulations, and step-by-step solutions. Challenges included poor internet connectivity, subscription limitations, and unfamiliar interfaces. Participants intend to integrate these applications into their future classrooms to promote student engagement, an interactive environment, and a deeper understanding of mathematics. These insights underscore the need for teacher education programs to embed training on educational technologies, equipping preservice teachers with the competencies to effectively integrate digital tools in mathematics instruction.

RESUMO

Este estudo adota um delineamento qualitativo narrativo para explorar o papel dos aplicativos de matemática nas trajetórias de aprendizagem de futuros professores de Matemática. Os dados foram coletados por meio de entrevistas com 15 futuros professores em La Union. Os resultados revelaram o uso do GeoGebra, Photomath, Gauthmath, Mathway e Khan Academy para aprimorar a compreensão conceitual por meio de visualizações, simulações e soluções passo a passo. Os desafios incluíram a má conectividade à internet, limitações de assinatura e interfaces pouco familiares. Os participantes pretendem integrar esses aplicativos em suas futuras salas de aula para promover o engajamento dos alunos, um ambiente interativo e uma compreensão mais profunda da matemática. Esses insights ressaltam a necessidade de que os programas de formação de professores incluam treinamento em tecnologias educacionais, capacitando os futuros professores com competências para integrar de forma eficaz ferramentas digitais no ensino da Matemática.

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Introdução

The 21st century has seen rapid technological advancements that have transformed every aspect of human life, including education (Kalyani, 2024). These advancements have redefined conventional classrooms into dynamic, interactive learning environments, allowing seamless access to vast information and resources (Kokkinos, 2024). Consequently, these transformations have brought a paradigm shift in the education system that paves innovative teaching and learning methods that enhance student interest and understanding (Haleem et al., 2022).

Mathematics education has improved due to the emergence of digital technology. These technologies have become pervasive in classroom teaching and learning (Wali et al., 2020). They have become essential in shaping preservice mathematics teachers' learning experiences and pedagogical approaches (Hidayat et al., 2024). Preservice mathematics teachers preparing for their careers as educators have greatly benefited from these tools. These tools aid in achieving academic excellence, enhancing the rate at which different mathematical concepts are assimilated, and accomplishing mathematics tasks more easily and faster (Gyimah, 2019). As they prepare for their future roles, these contribute to enhancing their teaching competency in mathematics (Jun-On et al., 2022).

Digital tools like GeoGebra, Desmos, Wolfram Alpha, and Photomath enable learners to visualize math concepts, investigate patterns, and participate in interactive problem-solving activities (Ghose et al., 2024). Maximizing these tools can create a dynamic learning environment that fosters engagement and accessibility (Pashchenko et al., 2024).

GeoGebra is one of the tools that preservice teachers find excellent for creating engaging and interactive lessons. It effectively teaches geometric transformation by visualizing and manipulating objects (Ikhsan et al., 2024). Thus, it clarifies complex concepts and boosts teachers' confidence in teaching geometry (Zutaah et al., 2023).

Furthermore, supplementary books integrated with GeoGebra and Maple applications can enhance preservice teachers' understanding of linear algebra (Abdilla, 2023). This provides content and solutions to deepen understanding of linear algebra concepts and fosters critical thinking skills, problem-solving abilities, creativity, innovation, and the mathematical literacy essential for 21st-century society.

Campuzano et al. (2022) revealed in their study that using Wolfram Alpha, one of the math applications, significantly impacted the learners' academic achievement. They viewed the application positively, recommending its use in regular courses to improve visual representation, understanding of theoretical concepts, and step-by-step problem-solving. Accessible via web browser, Wolfram Alpha facilitated interactive activities and supported distance learning by providing immediate feedback, enhancing the use of technology in education.

The study conducted by Kusi et al. (2025) revealed that using the Photomath app in teaching quadratic equations offers many benefits: solving problems independently, boosting engagement and interest, and enhancing confidence in tackling challenging problems, which leads to positive academic performance. Meanwhile, Paulin et al. (2024) integrated the Symbolab Calculator, which significantly improved students' performance and understanding, reducing the time to solve the trigonometric equations.

A quasi-experimental study conducted by Alvarez et al. (2024), with the goal of identifying the roles of the Desmos Graphing Calculator in Analytic Geometry and Calculus, found that experimental groups exhibit high satisfaction with Desmos' features, such as action, color appearance, and equation plotting. It greatly enhances their understanding of these topics compared to conventional approaches, indicating their effectiveness as a teaching aid.

These applications demonstrate distinct strengths in supporting mathematics learning. Geogebra and Desmos are effective for visualizing and exploring mathematical concepts that make abstract ideas clearer. Photomath and Gauthmath focus on developing procedural skills by giving step-by-step solutions to problems. Wolfram Alpha provides strong computational functions that are useful for advanced calculations, while Khan Academy offers structured lessons, practice exercises, and instructional videos for continuous learning. Collectively, these tools address different aspects of learning such as conceptual, procedural, computational, and instructional which can enhance the preparation of preservice teachers.

The emergence of these platforms has significantly transformed mathematics education supporting the study by Tamur et al. (2020), which found that they have a greater impact on mathematical ability than conventional methods. Meanwhile, Zamir et al. (2023) found in their study that preservice teachers face several challenges when using these applications. These challenges include scanning online materials, encoding mathematical language, and having limited awareness of the different math applications. Consequently, teacher education programs include digital literacy in the curriculum to prepare students for the seamless integration of Artificial Intelligence (AI) (Falebita, 2024).

However, a literature review survey shows that most studies have used quantitative methods established by various researchers. This may overlook the deeper qualitative insights into students' perceptions and challenges in using the different math applications. This study explores the learning journeys of preservice mathematics teachers as they work with various mathematical applications. It aims to explore the impact of these digital tools on their comprehension of mathematical concepts, problem-solving skills, and general teaching methods. This study may provide valuable insights into how digital tools can be integrated into mathematics education and support preservice teachers in embracing technological advancements.

Methodology

Research Design

This study employed narrative qualitative research design to explore the experiences of preservice mathematics teachers. It examines their perceptions, challenges, and learning journeys using mathematics applications.

Sources of Data

The study participants were 15 third-year students (11 female and 4 male), ranging in age from 19 to 21 years, who were enrolled in Number Theory, Calculus 2, Analytic Geometry, and Set and Logic in a teacher education program from a higher institution in La Union. In discussing the results, only the data gathered from 15 preservice mathematics teachers were analyzed and discussed. For ethical considerations, every participant was asked for their informed consent, and no student will be forced to participate in the study. To ensure confidentiality anonymity, they were assigned pseudonymous identifiers (e.g. P1, P2, P3) throughout the analysis and reporting of findings.

Instrumentation and Data Collection

The study employed semi-structured interviews to explore how math applications support preservice mathematics teachers in their learning journeys, enhance their pedagogical practices, and challenges they face while using these technologies. The semi-structured interviews followed a flexible guide with open-ended questions that enabled participants to share their experiences. The research instrument was administered through face-to-face interactions.

Data Analysis Procedures

The study used the participant's responses to identify codes, categorized the codes according to their meaning, and then identified the significant codes to analyze the data using the thematic method. This approach highlighted the personal experiences of preservice mathematics teachers with these tools. Through their narratives, the study provided a deeper understanding of how these resources influenced their growth as future educators.

Results and Discussion

Theme 1: Types and Features of Mathematics Applications Used

The participants reported various mathematics applications that supported their learning, with Geogebra and Photomath being the most commonly mentioned. Other identified tools included Gauthmath, Mathway, and Khan Academy.

Geogebra was highlighted for its graphing features, which enable users to plot equations, transform shapes, and explore geometric constructions. Photomath and Gauthmath were primarily utilized for their step-by-step solution features, which help learners understand the procedures involved in solving mathematical problems.

Participants stated:

"The math software I used is Geogebra. It is useful in determining geometric transformation, algebraic equations, and statistical data."-P1

" I used Khan Academy because it offers interactive video lessons along with practice exercises that help me understand and apply mathematical concepts."

P6

"I used GauthMath as a learning tool for mathematics. It provides step-by-step solutions and is user-friendly, allowing problems to be quickly solved by simply capturing an image of the question."- P14

"Photomath provided step-by-step solutions which helped me understand how to solve."- P7

The integration of digital tools into mathematics education has significantly influenced the way learners learn mathematical concepts (Cirneanu & Moldoveanu, 2024). It was indicated from the responses of preservice mathematics teachers that a diverse range of mathematics applications and platforms had been utilized to support their learning experiences. These applications were considered valuable tools for enhancing understanding despite their differences in features and complexity.

Theme 2: Influence of Math Applications on Understanding Mathematical Concepts

Many participants explained that Geogebra enables them to visualize mathematical ideas that are difficult to conceptualize using conventional methods. Through its graphing features, they were able to manipulate figures, observe transformations, and analyze the behavior of functions. Moreover, several math applications also contributed to procedural understanding. Step-by-step solutions offered by Photomath and Gauthmath help them obtain the correct answers and understand the underlying principles and logic behind them.

Participants stated:

"It helped me clearly visualize graphs and better connect equations with their visual representations, eliminating the errors that might occur if I were to draw or sketch them manually."- P15

"The visual and interactive features allowed me to better understand how equations and functions behave, particularly in relation to graphing and geometry concepts."-P3

"It provides step-by-step solutions, which help me gain a deeper understanding of mathematical concepts."- P5

"It helps me understand mathematical concepts because it explains the solutions clearly, showing how each answer is derived."-P12

The emergence of digital tools has significantly impacted learning as it enhances understanding of mathematical concepts (Drijvers & Sinclair, 2024). These experiences align with constructivist theory, which emphasizes the role of these tools in promoting deeper conceptual learning. Furthermore, this supports the study conducted by Cozad and Riccomini (2016), which found that digital tools can improve procedural fluency.

The participants' experiences underscore the varied ways mathematics applications influence understanding mathematical concepts. These tools play a significant role in mathematics education by making abstract concepts more concrete and supporting procedural mastery.

Theme 3: Challenges Encountered in Using Math Applications

Despite the positive impact of using math applications, several challenges emerged from the participants' experiences. These challenges encompass technical constraints, usability issues, and lack of familiarity. Participants consistently highlighted poor internet connectivity as a significant challenge. This limits user experience and productivity as these applications rely on stable online access to function effectively. Some applications were also limited by device compatibility or required premium subscriptions for full access. While these tools are recognized for making mathematics more engaging and accessible, most participants feel unprepared to utilize them effectively. They frequently expressed uncertainty about navigating the various applications.

Participants stated:

“One challenge I encountered when using these math applications was poor internet connectivity, since they require a stable connection to access and use”

- P1

"It needs a subscription to fully access the step-by-step process of solving a certain problem."- P9

“At times, I found the interface confusing and difficult to navigate, particularly when entering more complex equations.”- P4

“My lack of skills in using the app makes it difficult for me to maximize its features.” P2

The challenges often stem from insufficient exposure to various math applications, which limits their ability to maximize the benefits of these resources. These highlight the importance of providing preservice mathematics teachers with training on digital pedagogical tools, as emphasized in the Technology Acceptance Model (Davis, 1989), which identifies ease of use and perceived usefulness as crucial to technology adoption.

Theme 4: Integration of Math Applications in Future Teaching Practices

Several participants mentioned that they plan to use applications to visually demonstrate mathematical concepts, specifically in lessons involving graphing, linear equations, and transformations. The interactive features of some applications were seen as valuable for real-time simulations and manipulations of mathematical objects. In addition, participants also highlighted the role of these applications in increasing student engagement. Some participants envisioned using these tools in gamified educational activities that aim to make mathematics more interactive and enjoyable. Others noted using applications for flipped learning, where students would engage with content such as instructional videos or practice problems outside of class to prepare for deeper discussion during in-person sessions.

Participants stated:

"I plan to use Math applications to visualize the concepts to make lessons more engaging and interactive."-P5

"I can integrate it by letting students first solve problems manually and then use the mathematical applications to verify the accuracy of their answers."- P13

"Since many people are already using it, I could also use it to share videos related to the topic, lesson, or specific mathematical concepts whether for flipped learning or as instructional material to help students understand more clearly."- P8

"At present, I view it as an opportunity to incorporate these math applications into game-based approaches to enhance student's learning experiences in mathematics."-P2

Participants recognized the potential of math applications to enhance teaching and learning processes. They expressed strong interest in integrating these tools into their future classroom. Their responses demonstrated a growing awareness of the changes within mathematics education. This indicates they are eager to utilize these tools in their future classrooms. Their plans to integrate math applications into instructional practices align with the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006). This framework underscores the importance of effectively combining content, pedagogy, and technology in effective teaching.

Conclusion

The study delved into the experiences and perspectives of preservice mathematics teachers enrolled in a higher institution in La Union using mathematics applications. Through semi-structured interviews, insights were gathered on how preservice mathematics teachers utilized these applications, the challenges they encountered, and the potential for integrating these tools in their future endeavors.

The findings indicate that applications such as Geogebra, Photomath, Mathway, and Gauthmath are the most frequently mentioned applications used by preservice mathematics teachers to support their learning. Their features supported future math educators in visualizing abstract concepts and providing a more structured approach to problem-solving. However, preservice mathematics teachers encountered challenges related to poor internet connectivity, unfamiliar or complicated interfaces, and limited features of specific applications without subscription access.

Aligned with these findings is the intention of the participants to integrate digital tools in their future classrooms. By integrating these tools into their teaching practices, preservice mathematics teachers aim to create more interactive, engaging, and conceptually rich learning environments that promote a deeper understanding of mathematics.

Indeed, digital resources can enhance learning. Thus, they must be integrated meaningfully to optimize their advantages. Teacher education institutions should therefore consider embedding app-specific training modules and digital pedagogy courses into the curriculum. By doing so, institutions can ensure that future mathematics educators are equipped to maximize the potential of educational technologies and to foster student engagement and understanding in 21st century mathematics education.

REFERENCES

- Abdillah, A. (2023). Strengthening Preservice Teachers Conceptual Understanding of Linear Algebra by Using the Supplementary Book Integrated with the GeoGebra and Maple Applications. *Mathline: Jurnal Matematika dan Pendidikan Matematika*, 8(2), 705-724.
- Campuzano, M. G., & Crisanto, T. (2022). Learning analytic geometry with the aid of Wolfram Alpha. *International Journal of Innovative Science and Research Technology*, 7(1), 722-727.
- Cirneanu, A. L., & Moldoveanu, C. E. (2024). Use of digital technology in integrated mathematics education. *Applied System Innovation*, 7(4), 66.
- Cozad, L. E., & Riccomini, P. J. (2016). Effects of digital-based math fluency interventions on learners with math difficulties: A Review of the literature. *Journal of Special Education Apprenticeship*, 5(2), n2.
- Drijvers, P., & Sinclair, N. (2024). The role of digital technologies in mathematics education: purposes and perspectives. *ZDM—Mathematics Education*, 56(2), 239-248.
- Falebita, O. S. (2024). Assessing the relationship between anxiety and the adoption of Artificial Intelligence tools among mathematics preservice teachers. *Interdisciplinary Journal of Education Research*, 6, 1-13.

- Ghose, A., Chel, M. M., & Mahabidyalaya, S. (2024). Centre for pedagogical studies in mathematics: Challenges in mathematics education.
- Gyimah, A. N. T. H. O. N. Y. (2019). The use of smartphone mathematics applications among preservice mathematics teachers at teacher universities in Ghana (Doctoral dissertation, University of Education, Winneba.(UEW)).
- Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable operations and computers*, 3, 275-285.
- Hidayat, R., Zainuddin, Z., & Mazlan, N. H. (2024). The relationship between technological pedagogical content knowledge and belief among preservice mathematics teachers. *Acta Psychologica*, 249, 104432.
- Ikhsan, M., Rochaminah, S., & Mastura, A. (2024). The Development of Geo-Math Application by Integrating Geo-Gebra Applets to Improve Students' Spatial Ability. *Jurnal Ilmiah Peuradeun*, 12(3), 1129-1154.
- Jun-On, N., Suparatulatorn, R., Kaewkongpan, D., & Suwanreung, C. (2022). Enhancing Preservice Mathematics Teachers' Technology Integrated Competency: Cooperative Initiation and Open Lesson Observation. *International Journal of Information and Education Technology*, 12(12), 1363-1373.
- Kalyani, L. K. (2024). The role of technology in education: Enhancing learning outcomes and 21st century skills. *International journal of scientific research in modern science and technology*, 3(4), 05-10.
- Kokkinos, L. (2024). Revolutionizing education: The dynamic intersection of technology and learning. *Educational Research (IJMCER)*, 6(1), 26-32.
- Kusi, P., Boateng, F. O., & Teku, E. (2025). The effect of technology integration on college of education students' achievement in quadratic equations: The perspective of photo math utilization. *Eurasia Journal of Mathematics, Science and Technology Education*, 21(1), em2561.
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers college record*, 108(6), 1017-1054.
- Pashchenko, O., Skorupska, O., & Zhuravel, A. (2024). THE ROLE OF TECHNOLOGY IN MATH EDUCATION. *Collection of scientific papers «SCIENTIA»*, (November 1, 2024; Lisbon, Portugal), 168-176.
- Paulin, M., & Ndagijimana, J. B. (2024). Effectiveness of the Symbolab Calculator in Improving Second Year Science and Mathematics Students Ability to Solve Trigonometric Equations. *East African Journal of Education and Social Sciences*, 4(6), 10-46606.

- Tamur, M., Juandi, D., & Kusumah, Y. S. (2020). The Effectiveness of the Application of Mathematical Software in Indonesia; A Meta-Analysis Study. *International Journal of Instruction*, 13(4), 867-884.
- Wali, A., & Popal, A. (2020). The emerging issues and impacts of technology in classroom learning. *International Journal of Emerging Technologies in Learning (iJET)*, 15(15), 237-245.
- Zamir, S., & Ali, H. (2023). Prospective Teachers' Perceptions, Reliance, and Barriers to ICT Integration in Mathematics Learning. *Journal of Education and Educational Development*, 10(1), 7-25.
- Zutaah, P., Ondigi, S. R., & Miheso-O'Connor, M. K. (2023). PRESERVICE TEACHERS' PERCEPTION OF THE USE OF GEOGEBRA IN TEACHING AND LEARNING GEOMETRY IN THE COLLEGES OF EDUCATION, GHANA. *JOHME: Journal of Holistic Mathematics Education*, 7(1), 1-21.