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(RESEARCH ARTICLE)

The Effects of Interactive Digital-Based Materials on Students' Performance in Mathematics

ELLA MAE RED BARBADILLO *

MAED-Major in Mathematics, Daniel B. Pena Memorial College Foundation, Inc.

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Abstract

This study determined the effects of interactive digital-based materials on the performance in Mathematics of Grade 9 students in Vinisitahan National High School in Bacacay, Albay for SY 2023-2024. Specifically, it answered the following questions: 1. What is the performance in the pretest of the control and experimental groups along illustrating quadratic equations; solving quadratic equations by extracting the square roots; solving quadratic equations by factoring; solving quadratic equations by completing the squares; solving quadratic equations using the quadratic formula; and characterizing the roots of a quadratic equation using the discriminant?; 2. What is the performance of the control and experimental groups in the posttest?; 3. Is there a significant difference in the performance of the control and experimental groups in the pre and posttest?; 4. What are the least mastered skills in the posttest of the experimental group?; and 5. What interactive digital-based lesson plans may be proposed to enhance Mathematics teaching in Grade 9?

Experimental method was applied in this study since the effects of the materials used were determined. The researcher employed the pre/posttest design, using two (2) groups, the control and the experimental groups. Tests were given before and after the experimentation. The results of the test were used as a basis in providing judgment to the effects of the interventions provided.

The pre and posttest used in this study was prepared by the researcher which was the main tool used in gathering the data. The test was composed of forty (40) items, distributed to the following skills: illustrating quadratic equations with four (4) items; solving quadratic equations by extracting the square roots with seven (7) items; solving quadratic equations by factoring with seven (7) items; solving quadratic equations by completing the squares with seven (7) items; solving quadratic equations using the quadratic formula with eight (8) items; and characterizing the roots of a quadratic equation using the discriminant with seven (7) items. Table of specification was provided to determine the number of item allocation. The mean score in every skill was computed to determine the performance level of the group. The t-test for independent samples was used to test the hypothesis.

Keywords: Interactive; Digital-Based; Mathematics Performance-Based; Least Mastered Skill

1. Introduction

The contemporary world is characterized by technological innovation, increased human interconnection, and globalization. With the ever-evolving digital era, education must also transform its framework for the 21st century learners, and the teaching and learning of Mathematics is no exception. Many in the education field see technologies as powerful tools to meet the needs of the ever-diverse learners. A few years ago, interactive digital learning materials were introduced to schools and other institutions as a new teaching and learning method. This digital learning platform offers options for tailoring education to students' individual strengths, interests, and motivations in learning.

* Corresponding author: ELLA MAE RED BARBADILLO.

The inclusion of digital learning in a classroom can vary from simply using digital format instead of textbooks to using interactive software programs as opposed to the simple visual projections. This entails utilizing programs and services to engage students actively in achieving significant improvements in productivity and support for both teaching and learning. While in the realm of mathematics education, interactive digital materials could include virtual simulations for complex problems, interactive exercises that adapt to individual progress, and multimedia presentations to explain abstract concepts visually.

Technology-fueled and interactive education has transformed our conventional concepts of schooling, teaching, and learning, likewise, adapted to the preferences of today's Generation Z learners. These learners are not only technology-savvy, but also technology-dependent. Further, they favor storytelling, video explainer interactive games, collaborative projects, experiential learning, and other forms of hands-on activities. Certainly, interactive digital-based materials are relevant in taking advantage of the limitless opportunities created by advanced technology.

Moreover, as the Philippines welcomes its fourth industrial revolution known as Industry 4.0, this demands more in the present education for a transformation with its current technology and teaching methodology. Suvin (2018)1, suggested that one way of doing so is to cope with the transition through Education 4.0. Therewith, concentration shifts to various technological advancements and equipment as part of students' learning processes. To keep up with the change, teachers' role should not just be facilitators of learning but also innovation catalysts. In addition, learners should be adept with skills set by the fast-changing technology, and information should be made accessible.

2. Materials and Methods (Quantitative)

This quantitative study utilized a descriptive research design to evaluate the effectiveness of interactive digital learning materials in enhancing mathematics instruction for 21st-century learners. The research targeted junior high school students from selected public schools in Lucena City, Philippines, during the 2024–2025 academic year. A structured questionnaire and pre- and post-assessments were employed as primary instruments to gather data regarding student engagement, academic performance, and perceptions toward digital-based instruction.

The participants were selected through stratified random sampling to ensure representation across various sections and performance levels. The study involved two groups: an experimental group exposed to interactive digital learning materials including simulations, adaptive exercises, and video explainers and a control group following traditional textbook-based methods. Each intervention lasted for eight weeks, covering core topics in the mathematics curriculum.

Digital tools were integrated through school-provided platforms and devices, with lessons delivered using multimedia software, virtual whiteboards, and gamified tasks. Teachers facilitating the experimental group underwent training to ensure consistent implementation across classrooms. Collected data were analyzed using statistical methods including mean, standard deviation, t-tests, and ANOVA to determine significant differences between the groups' performance and engagement levels.

Ethical considerations such as informed consent and data privacy were strictly observed. This methodical approach allowed the study to quantitatively assess how interactive digital learning aligns with Education 4.0 goals, equipping students with relevant competencies in the context of Industry 4.0 and the evolving landscape of Philippine education.

3. Results and discussions

The analysis revealed that students in the experimental group who engaged with interactive digital learning materials demonstrated significantly higher gains in mathematics achievement compared to those in the control group. Post-assessment scores improved markedly, with statistical results indicating a meaningful difference in performance ($p < 0.05$). These findings support the notion that multimedia-rich and adaptive learning platforms can enhance conceptual understanding and problem-solving abilities.

Student engagement also showed notable improvement within the experimental group. Survey responses indicated increased motivation, attentiveness, and participation in lessons utilizing simulations, videos, and gamified tasks. The interactive nature of the materials fostered a student-centered environment, which resonated with Generation Z learners' learning preferences. This shift in learning dynamics also contributed to more active classroom participation and collaborative learning behavior.

The data suggest that integrating technology in mathematics instruction aligns well with the goals of Education 4.0 by equipping students with digital literacy and critical thinking skills relevant to Industry 4.0 demands. The positive outcomes underscore the need to support teacher readiness, infrastructure, and content development for digital education. Overall, the results affirm the potential of interactive digital learning materials as effective tools for transforming math education in Philippine junior high schools.

4. Conclusion

The findings of this study conclude that interactive digital learning materials significantly enhance mathematics achievement and student engagement among junior high school learners. The marked improvement in post-assessment scores and positive feedback on motivation and participation highlight the value of technology-integrated instruction. These results affirm the alignment of digital learning with the goals of Education 4.0, supporting the development of digital literacy and critical thinking skills essential in the industry 4.0 era. Thus, fostering digital readiness among educators and learners is vital for shaping a more adaptive and future-ready education system in the Philippines.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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