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The Use of Math Apps and Gadgets in Learning Grade 7 Mathematics of Llanera District

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ABSTRACT

This study evaluated the use of mathematics applications and gadgets in learning Grade 7 Mathematics in the Llanera District during School Year 2025–2026 as a basis for developing a Localized Digital Mathematics Instructional Framework. Anchored on the Technological Pedagogical Content Knowledge (TPACK) Framework, SAMR Model, and Bruner's Theory of Cognitive Representation, the study employed a sequential explanatory mixed-methods design involving 435 Grade 7 learners and 11 mathematics teachers. Data were gathered through validated researcher-developed questionnaires, curricular alignment checklists, and official academic records, and analyzed using descriptive statistics, Pearson correlation, and thematic analysis. Results revealed that 85.98% of learners primarily used smartphones, 68.51% relied on prepaid mobile data, and 60.00% preferred Photomath. Mathematics application utilization was generally low (weighted mean = 2.29), with the highest utilization in Elementary Algebra (2.84) and the lowest in Geometry (1.88). Curricular alignment was highest in Algebra (83.33%) and lowest in Geometry (40.00%). Learners demonstrated moderate engagement (2.62), low positive attitudes toward mathematics (2.18), and fairly satisfactory academic performance (81.45). A statistically significant positive relationship was established between application utilization and academic performance ($r = 0.384$, $p = 0.002$). Major challenges included unstable internet connectivity (87.81%), application subscription costs (67.58%), and inadequate teacher training (72.72%). The study recommends offline-accessible, curriculum-aligned mathematics applications and targeted teacher professional development. It supports Sustainable Development Goals 4 (Quality Education), 9 (Industry, Innovation and Infrastructure), 10 (Reduced Inequalities), and 17 (Partnerships for the Goals). Its sustainability contribution lies in promoting equitable digital learning access, efficient utilization of existing technological resources, institutional collaboration, and context-responsive instructional practices that can strengthen long-term mathematics education.

Keywords: *Academic Performance, Digital Learning, Grade 7 Mathematics, Learner Engagement, Mathematics Applications, Mathematics Education, Sustainable Development Goals, Technological Pedagogical Content Knowledge, Technology Integration*

1. INTRODUCTION

The integration of digital technology into mathematics education has created opportunities for interactive, personalized, and competency-based learning. Mathematics applications and gadgets can support conceptual understanding, problem-solving, and learner engagement, particularly during the transition from elementary arithmetic to the abstract concepts introduced in Grade 7. In the Philippines, the Department of Education (DepEd) promotes Information and Communications Technology (ICT) integration to strengthen instructional quality and develop learners' 21st-century competencies. The implementation of the MATATAG Curriculum provides an important policy context for examining the alignment of digital mathematics resources with prescribed learning standards (Department of Education, 2024a, 2024b). Despite these opportunities, effective technology integration remains challenging in rural and suburban educational settings. The OECD (2023b) examined how education systems responded to disruptions in learning, highlighting the importance of resilient educational practices and supportive learning environments. Similarly, UNESCO (2023) emphasized the need to consider equity, accessibility, and educational effectiveness when integrating technology into teaching and learning. These perspectives are relevant to the Llanera District, where differences in device availability, internet connectivity, socioeconomic conditions, and teachers' digital competencies may influence the educational benefits of mathematics applications. UNESCO (2023) discusses the importance of equitable access, infrastructure, and pedagogical appropriateness in educational technology. In the present study, smartphone dependence, prepaid internet access, and application costs are examined as local conditions that may affect digital mathematics learning. This study evaluates the utilization, curricular alignment, and educational implications of mathematics applications and gadgets among Grade 7 learners in the Llanera District during School Year 2025–2026. It examines student engagement, attitudes toward mathematics, academic performance, and technological barriers to develop a Localized Digital Mathematics Instructional Framework that supports accessible, effective, and sustainable mathematics education.

Research Problem

Grade 7 Mathematics presents significant learning challenges as students transition from concrete arithmetic to abstract concepts in Elementary Algebra, Geometry, and Statistics. Traditional instructional approaches may limit conceptual understanding, increase mathematics anxiety, and reduce learner engagement. Although digital applications offer interactive learning opportunities, their effectiveness depends on purposeful integration, curricular alignment, and accessibility. The Department of Education (2020) provided guidance on the use of Most Essential Learning Competencies (MELCs), which serve as an important reference for evaluating whether instructional resources address prescribed learning objectives. Furthermore, the OECD (2024) examined creative thinking and the educational conditions associated with its development, reinforcing the importance of learning opportunities that extend beyond routine procedures. These considerations underscore the need to evaluate mathematics applications not only for computational assistance but also for their potential to support conceptual understanding, problem-solving, and meaningful learner participation. UNESCO (2023) stresses that educational technology should be evaluated in relation to learning goals, context, and evidence of effectiveness. OECD (2023a) provides broader evidence on mathematics learning and educational equity, rather than documenting the use of specific mathematics applications across Algebra, Geometry, and Statistics. The SAMR Model (Puentedura, 2006) offers a framework for examining whether technology is used primarily for substitution and augmentation or for more substantial instructional transformation. In the Llanera District, the central research problem concerns the extent to which mathematics applications and gadgets are effectively utilized to support Grade 7 learning despite technological and pedagogical limitations. The study specifically examines the learners'

demographic and technological profiles, application utilization across mathematical domains, alignment with DepEd Most Essential Learning Competencies (MELCs), engagement, attitudes, academic performance, and barriers encountered by students and teachers. The investigation is limited to 435 Grade 7 learners and 11 mathematics teachers in public secondary schools within the Llanera District. It also determines whether a statistically significant relationship exists between mathematics application utilization and academic performance, providing a basis for localized instructional guidelines and recommendations.

Assumptions of the Study

The study assumes that the 435 Grade 7 student-respondents and 11 mathematics teachers provide honest, accurate, and objective responses concerning mathematics application utilization, learner engagement, attitudes, and technological challenges. It further assumes that the students' official quarterly grades, obtained from DepEd School Form 10 (SF10/Form 137), are accurately recorded and constitute reliable indicators of academic performance. The study also assumes that the Technological Pedagogical Content Knowledge (TPACK) Framework, Substitution, Augmentation, Modification, Redefinition (SAMR) Model, and Bruner's Theory of Cognitive Representation are applicable to the educational context of the Llanera District. These frameworks are considered appropriate for examining teachers' technological competencies, instructional integration, and learners' conceptual development. Finally, the study assumes that available smartphones, tablets, and mathematics applications can support Grade 7 instruction when appropriately aligned with the DepEd MELCs. Despite differences in socioeconomic conditions, connectivity, and digital literacy, these technologies are assumed to provide opportunities for accessible and improved mathematics learning.

Objectives of the Study

The general objective of this study is to evaluate the use of mathematics applications and gadgets in learning Grade 7 Mathematics in the Llanera District during School Year 2025–2026 as a basis for developing a Localized Digital Mathematics Instructional Framework. Specifically, the study aims to determine the socioeconomic and technological profiles of Grade 7 learners, including their access to digital gadgets and mathematics applications; assess the extent of mathematics application utilization in Elementary Algebra, Geometry, and Statistics; evaluate the alignment of utilized applications with the Department of Education (DepEd) Most Essential Learning Competencies (MELCs); examine learners' engagement, attitudes and anxiety toward mathematics, and academic performance based on quarterly grades; determine the significant relationship between mathematics application utilization and students' academic performance; identify the technological, infrastructural, and pedagogical barriers encountered by learners and teachers; and develop a Localized Digital Mathematics Instructional Framework with corresponding recommendations to improve technology-supported mathematics instruction. Furthermore, the study tests the null hypothesis that no significant relationship exists between the extent of mathematics application utilization and Grade 7 learners' academic performance at the 0.05 level of significance.

Conceptual and Theoretical Framework

This study is anchored on three complementary frameworks: the Technological Pedagogical Content Knowledge (TPACK) Framework, the SAMR Model, and Bruner's Theory of Cognitive Representation. Together, these explain the pedagogical requirements, instructional integration, and cognitive processes associated with technology-supported mathematics learning. The TPACK Framework, developed by Mishra and Koehler (2006), emphasizes the integration of Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK) in effective instruction. It provides the basis for examining teachers' capacity to select and utilize mathematics applications that support Grade 7 learning competencies. Mishra and Koehler

emphasized that technological proficiency alone is insufficient without appropriate pedagogical and content integration. Puentedura (2006) developed the SAMR Model, which describes four levels of technology integration: Substitution, Augmentation, Modification, and Redefinition. It distinguishes basic technological replacement from instructional transformation. UNESCO (2023) emphasizes the importance of assessing the educational value of technology rather than assuming that technology use alone improves teaching and learning. Bruner (1966) proposed the Theory of Cognitive Representation, which explains learning through Enactive, Iconic, and Symbolic representations. The theory supports the use of interactive mathematics applications to bridge visual and abstract mathematical understanding. Bruner's framework is particularly relevant to Grade 7 learners transitioning toward algebraic reasoning. UNESCO (2023) likewise underscores the need for evidence-based decisions about the pedagogical use of digital tools. The study further adopts the Input-Process-Output (IPO) Model as its conceptual framework. Inputs include learner profiles, gadget availability, application utilization, MELC alignment, engagement, attitudes, academic performance, and systemic barriers. The process involves validated questionnaires, academic record reviews, descriptive and inferential statistical analyses, and diagnostic assessment of technological challenges. The intended output is a Localized Digital Mathematics Instructional Framework comprising contextualized application guides, offline learning strategies, and instructional and administrative recommendations. Collectively, these frameworks guide the evaluation of mathematics application utilization and its relationship with learner outcomes within the educational and technological conditions of the Llanera District.

Sustainable Development Goal and Multidisciplinary Sustainability Relevance

The study primarily supports Sustainable Development Goal 4 (Quality Education) by examining how mathematics applications and gadgets can improve access to engaging, inclusive, and effective learning opportunities. Its emphasis on curriculum-aligned digital instruction, learner engagement, academic achievement, and teacher competencies contributes to educational sustainability by identifying strategies that can strengthen mathematics instruction within existing technological limitations. The research also aligns with SDG 9 (Industry, Innovation and Infrastructure) through its examination of educational technology integration and the infrastructural barriers affecting digital learning. By identifying connectivity limitations, device constraints, and application accessibility issues, the study provides a basis for recommending appropriate, affordable, and offline-capable digital learning solutions. These contributions support technological and digital sustainability through the more effective use of available educational resources. Furthermore, the study is relevant to SDG 10 (Reduced Inequalities) because it considers socioeconomic differences and unequal access to digital learning resources among learners in rural and suburban communities. Its proposed localized instructional framework seeks to address technological disparities by recommending context-sensitive approaches that accommodate varying levels of connectivity, device availability, and digital literacy. The study also contributes to SDG 17 (Partnerships for the Goals) through its potential to inform collaboration among mathematics teachers, school administrators, DepEd officials, and educational researchers in developing and implementing technology-supported instructional strategies. UNESCO (2024) emphasized the importance of educational leadership, professional development, and institutional collaboration in improving educational outcomes. Within the Llanera District, these principles support the proposed instructional framework's emphasis on coordinated implementation, teacher capacity-building, and sustained administrative support for digital mathematics education. Overall, the study contributes to educational, technological, socioeconomic, and institutional sustainability by promoting accessible digital mathematics instruction, strengthening teachers' instructional practices, and supporting evidence-based educational planning. Its proposed framework is intended to

improve the long-term integration of mathematics applications and gadgets while responding to the specific needs and limitations of the Llanera District.

2. METHODOLOGY

Research Design

The study adopted a mixed-methods research design using the Sequential Explanatory Strategy (Creswell & Creswell, 2018), consisting of quantitative and qualitative phases. The quantitative phase employed a descriptive-correlational approach to determine respondents' technological profiles, the extent of mathematics application utilization in Elementary Algebra, Geometry, and Statistics, and learners' engagement, attitudes, and academic performance. It also examined the relationship between application utilization and mathematics grades. The qualitative phase utilized a descriptive-diagnostic approach to identify technological, infrastructural, and pedagogical challenges experienced by students and teachers. Qualitative findings complemented the statistical results by providing contextual explanations of digital learning conditions. Both phases informed the development of the proposed Localized Digital Mathematics Instructional Framework.

Research Locale or Study Setting

The study was conducted in public secondary schools within the Llanera District under the Department of Education (DepEd) during School Year 2025–2026. The district provided the setting for examining mathematics application utilization within a rural-suburban educational environment characterized by varying levels of technological access, internet connectivity, and digital literacy. The investigation focused exclusively on Grade 7 Mathematics, particularly Elementary Algebra, Geometry, and Statistics, as prescribed by the DepEd Most Essential Learning Competencies (MELCs). The localized setting enabled the assessment of technology-supported instruction and the identification of challenges affecting its implementation.

Participants or Data Sources

The study utilized primary and secondary data sources. Primary respondents consisted of Grade 7 learners enrolled in public secondary schools in the Llanera District and their mathematics teachers. Students provided information regarding socioeconomic characteristics, gadget ownership, mathematics application utilization, engagement, attitudes, and learning challenges. Teachers supplied information concerning curricular alignment, instructional practices, and technological and pedagogical barriers. Stratified random sampling was employed for student selection to ensure proportional representation across participating schools. The required sample size was determined using Slovin's formula with a 0.05 margin of error. For mathematics teachers, purposive or total population sampling was adopted to include the district's eligible Grade 7 mathematics instructors. Secondary data consisted of students' official quarterly and final mathematics grades obtained from DepEd School Form 10 (SF10/Form 137) or authorized grading records. The DepEd MELCs served as the reference for evaluating the curricular alignment of mathematics applications.

Research Instruments or Materials

The primary research instrument was a researcher-developed questionnaire anchored on the Technological Pedagogical Content Knowledge (TPACK) Framework, SAMR Model, and Bruner's Cognitive Stages. It comprised four components covering respondents' socioeconomic and technological profiles, mathematics application utilization, learner engagement and attitudes, and systemic challenges. Application utilization across Elementary Algebra, Geometry, and Statistics was measured using a four-point Likert scale. Weighted mean scores were interpreted as highly utilized (3.50–4.00), moderately utilized (2.50–3.49), lightly utilized (1.50–2.49), and not utilized (1.00–1.49). Engagement and attitude responses were similarly interpreted using four

levels of agreement or engagement. An expert validation checklist was used to assess the alignment of mathematics applications with the DepEd MELCs. Content validity was established through evaluation by three specialists in mathematics education, curriculum development, and information technology from Lyceum-Northwestern University, using the Content Validity Index (CVI). The questionnaire was pilot-tested among 30 Grade 7 learners from an adjacent district who were excluded from the actual sample. Internal consistency was assessed using Cronbach's Alpha, with a minimum acceptable coefficient of 0.70.

Data Gathering Procedure

Data collection followed three sequential phases involving administrative approval, survey administration, and academic record retrieval. Initially, the researcher secured an endorsement from the Dean of the Institute of Graduate and Professional Studies at Lyceum-Northwestern University and requested authorization from the DepEd Schools Division Superintendent. Coordination with the Public Schools District Supervisor and participating school administrators established appropriate data collection schedules without disrupting regular classes. Following approval, parental consent and student assent were obtained before administering the validated questionnaires. Surveys were distributed personally or through coordinated digital or hybrid arrangements to participating Grade 7 learners and mathematics teachers. Respondents were informed of the study's objectives and assured of the confidentiality of their responses in accordance with the Data Privacy Act of 2012 (Republic Act No. 10173, 2012). Completed questionnaires were collected for processing and analysis. Subsequently, the researcher requested certified academic records or official electronic grading sheets from school registrars and class advisers. Mathematics quarterly grades for School Year 2025–2026 were extracted and matched with corresponding questionnaire identification codes. Quantitative and qualitative responses were consolidated into a master dataset for statistical processing and interpretation.

Data Analysis

Data were processed using the Statistical Package for the Social Sciences (SPSS) Version 28.0 and Microsoft Excel. Descriptive and inferential statistical techniques were employed to address the research objectives. Frequency counts and percentage distributions were used to describe respondents' socioeconomic and technological characteristics, mathematics application utilization, curricular alignment, and identified challenges. Weighted means determined the extent of application utilization, learner engagement, and attitudes toward mathematics, while standard deviations measured variations in responses. Academic performance was summarized using numerical grades and corresponding descriptive statistics. The Pearson Product-Moment Correlation Coefficient (r) was employed to determine the relationship between mathematics application utilization and academic performance. A two-tailed significance test was applied at the 0.05 significance level. The null hypothesis was rejected when the computed p-value was below 0.05. Frequency ranking was used to identify the most prevalent technological and instructional barriers. Open-ended responses were analyzed through thematic analysis following the approach described by Braun and Clarke (2021), involving the coding, categorization, and interpretation of recurring themes. Quantitative and qualitative findings were subsequently synthesized to develop the Localized Digital Mathematics Instructional Framework, supported by expert validation.

Ethical Considerations

The study observed institutional and educational research protocols to protect the rights, privacy, and welfare of participants. Necessary approvals were secured from Lyceum-Northwestern University, the DepEd Schools Division Office, and participating school administrators before data collection. Because the student respondents were minors, parental informed consent and student assent were required before participation. Respondents were

informed of the study's purpose, data collection procedures, and confidentiality measures. Personal information and academic records were handled in accordance with the Data Privacy Act of 2012 (Republic Act No. 10173, 2012). Official academic records were accessed through authorized school personnel and matched with questionnaire identification codes for analysis. The collected information was used exclusively for the research objectives, with appropriate confidentiality safeguards to protect participants' identities and academic information.

3. RESULTS AND DISCUSSION

3.1 Utilization of Mathematics Applications and Learner Outcomes

3.1.1 Socio-Demographic and Technological Profile of Learners

Among the 435 Grade 7 respondents, 374 (85.98%) primarily used smartphones for digital learning, followed by tablets (9.89%) and laptops or desktop computers (4.14%). Regarding internet access, 68.51% relied on prepaid mobile data, 18.85% had fixed Wi-Fi connections, and 12.64% had no internet access at home. Photomath was the most frequently utilized mathematics application (60.00%), followed by Kahoot/Quizizz (21.61%), GeoGebra (11.95%), and Microsoft Math Solver or offline mathematics games (6.44%). These findings indicate that digital mathematics learning in the Llanera District depends primarily on smartphones and prepaid internet connectivity. The preference for Photomath reflects learners' reliance on applications that provide immediate solutions and step-by-step mathematical explanations. However, limited connectivity and device capabilities may restrict access to more interactive learning resources, emphasizing the importance of mobile-compatible and offline-accessible mathematics applications.

3.1.2 Extent of Mathematics Application Utilization

The overall extent of mathematics application utilization obtained a weighted mean of 2.29, interpreted as Lightly Utilized. Elementary Algebra recorded the highest utilization (2.84), classified as Moderately Utilized, followed by Statistics (2.15) and Geometry (1.88), both classified as Lightly Utilized. The findings suggest that mathematics applications are used more frequently for algebraic computations than for geometric visualization and statistical analysis. Under the SAMR Model, this pattern indicates that technology integration remains largely within the Enhancement stage, particularly Substitution and Augmentation, where applications support conventional mathematical tasks rather than substantially transforming learning activities. The limited utilization of dynamic applications such as GeoGebra further reflects opportunities to strengthen interactive and conceptual mathematics instruction.

3.1.3 Alignment of Mathematics Applications with DepEd Learning Competencies

The assessment of 11 Grade 7 mathematics teachers revealed that mathematics applications demonstrated the highest alignment with the DepEd MELCs in Elementary Algebra, covering 10 of 12 targeted competencies (83.33%). Statistics showed moderate alignment, covering five of eight competencies (62.50%), while Geometry recorded the lowest alignment, covering four of 10 competencies (40.00%). These findings indicate that commonly utilized mathematics applications are more compatible with algebraic computations than with the conceptual and visual requirements of Geometry. Although automated mathematical solvers support symbolic operations, their limited coverage of curriculum-specific geometric competencies creates instructional gaps. This emphasizes the need to select and adapt mathematics applications according to prescribed learning competencies rather than relying solely on their computational features.

3.1.4 Learner Engagement, Attitudes, and Academic Performance

The learners demonstrated moderate classroom engagement, with a weighted mean of 2.62. However, their attitude toward mathematics obtained a weighted mean of 2.18, indicating low positive attitudes and high mathematics anxiety. The mean academic performance was 81.45, classified as Fairly Satisfactory. These results suggest that moderate learner engagement does not necessarily correspond to equally positive attitudes or high academic achievement. The findings reflect the challenges encountered by Grade 7 learners when transitioning from elementary arithmetic to more abstract mathematical concepts. The relatively low attitude score and fairly satisfactory academic performance underscore the need for instructional approaches that strengthen conceptual understanding, learner confidence, and meaningful participation in mathematics activities.

3.2 Challenges Affecting Mathematics Application Utilization

The most frequently reported challenge was unstable internet connectivity and limited home Wi-Fi access, affecting 382 learners (87.81%). This was followed by subscription costs and application paywalls, reported by 294 learners (67.58%), and device battery depletion or overheating, experienced by 185 learners (42.52%). Among the 11 mathematics teachers, eight (72.72%) identified inadequate training in technology-supported pedagogy, while seven (63.63%) reported insufficient localized, offline-accessible mathematics learning materials. These findings demonstrate that technological accessibility and instructional preparedness remain significant barriers to effective digital mathematics learning. Connectivity limitations and application costs restrict consistent access to educational resources, while insufficient teacher training affects the purposeful integration of mathematics applications. Viewed through the TPACK Framework, these challenges emphasize the importance of combining technological, pedagogical, and content knowledge to maximize the instructional value of available digital tools. The AI competency framework for teachers developed by Miao and Cukurova (2024) provides an additional perspective on the professional competencies educators may require as emerging technologies become increasingly integrated into educational practice. Although the present study did not directly assess teachers' artificial intelligence competencies, this framework offers a useful reference for future professional development initiatives involving AI-supported mathematics applications.

3.3 Relationship Between Mathematics Application Utilization and Academic Performance

The Pearson Product-Moment Correlation analysis yielded a correlation coefficient of $r = 0.384$ and a p-value of 0.002. Since the computed p-value was below the 0.05 significance level, the null hypothesis was rejected. The results established a statistically significant positive relationship between the extent of mathematics application utilization and the academic performance of Grade 7 learners. The positive correlation indicates that greater mathematics application utilization is associated with higher academic performance, although the relationship does not establish causation. This finding is consistent with Cheung and Slavin (2013), whose meta-analysis revealed that educational technology applications generally produce positive, although modest, effects on mathematics achievement among K–12 learners. Furthermore, the finding is consistent with Bruner's Theory of Cognitive Representation, which emphasizes the importance of visual representations in developing abstract mathematical understanding. Interactive mathematics applications may support learners' transition from

Iconic to Symbolic representations by making mathematical concepts more accessible through digital visualization and guided problem-solving.

3.4 Proposed Localized Digital Mathematics Instructional Framework

Based on the findings, the study proposed a Localized Digital Mathematics Instructional Framework for the Llanera District, emphasizing offline-accessible, curriculum-aligned mathematics applications and teacher professional development. Guided by the TPACK Framework and SAMR Model, the framework addresses connectivity limitations, application accessibility, curricular alignment, and teacher preparedness. Zhang et al. (2025) emphasized the positive effects of GeoGebra-supported visualization on mathematics achievement, while Hidayat and Firmanti (2024) highlighted the benefits and challenges of technology integration in mathematics education. Furthermore, Miao and Holmes (2023) and Miao et al. (2024) provided insights into responsible AI integration and digital competencies. Collectively, these perspectives support accessible, interactive, and sustainable mathematics instruction while providing directions for future AI-supported learning initiatives.

4. CONCLUSIONS AND RECOMMENDATIONS

The study concludes that the integration of mathematics applications and gadgets in Grade 7 Mathematics in the Llanera District remains limited by unstable internet connectivity, reliance on prepaid smartphones, and insufficient technological pedagogical training. Digital applications are primarily utilized for basic algebraic computations, reflecting the Enhancement stage of the SAMR Model rather than transformative learning practices. Nevertheless, the significant positive relationship between mathematics application utilization and academic performance supports Bruner's Theory of Cognitive Representation, indicating that interactive digital tools can facilitate the transition from visual to abstract mathematical understanding. The findings further reveal a Technological Pedagogical Content Knowledge (TPACK) deficit among teachers, particularly in aligning digital applications with the DepEd Most Essential Learning Competencies (MELCs). These conclusions emphasize the need for accessible, curriculum-aligned applications and improved teacher competencies to optimize digital mathematics instruction.

The study recommends adopting the proposed Localized Digital Mathematics Instructional Framework to strengthen technology-supported mathematics education in the Llanera District. School administrators should prioritize offline-accessible applications, such as GeoGebra Offline and open-source mathematical tools, and allocate resources for educational application licenses to address connectivity and subscription barriers. Mathematics teachers should integrate interactive digital activities and participate in Learning Action Cell (LAC) sessions to enhance technological pedagogical competencies and ensure alignment with DepEd MELCs. Parents should collaborate with teachers in guiding learners toward productive educational gadget use and supporting home-based mathematics practice. Lyceum-Northwestern University is encouraged to adopt the framework as a reference for graduate research, while future researchers should examine its long-term effectiveness across neighboring districts and investigate the influence of artificial intelligence-based mathematics applications on critical thinking and independent problem-solving.

The study's conclusions are situated within the technological, infrastructural, and instructional conditions of the Llanera District, particularly the limitations associated with internet connectivity, application accessibility, and teacher preparedness. The recommendation for longitudinal research across neighboring districts also indicates the need for further evaluation

of the proposed framework's effectiveness beyond the present setting. Future investigations may provide additional evidence concerning the sustained educational benefits of mathematics applications and their implications for learners' critical thinking and independent problem-solving abilities.

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