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The Effectiveness of the Technology-Assisted Learning Techniques in Improving the Academic Performance of the Grade 3 Learners in Mathematics in Capalonga District, Division of Camarines Norte

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ABSTRACT

This study investigated the effectiveness of technology-assisted learning techniques in improving the academic performance of Grade 3 learners in Mathematics in Capalonga District, Division of Camarines Norte, during the School Year 2024–2025. It specifically examined the extent of utilization of these techniques across five dimensions—engagement, personalized learning, visualization and conceptual understanding, immediate feedback, and data-driven instruction—and their corresponding impact on learners' cognitive domains, including knowledge, comprehension, analysis, application, and evaluation. Anchored on a descriptive–evaluative–correlational research design, the study utilized total enumeration of thirty-six (36) Grade 3 teachers. Data were analyzed using weighted mean, ranking, and Kendall's Coefficient of Concordance (W) with corresponding chi-square tests to determine the degree of agreement among respondents. The level of significance was set at 0.05. Findings revealed that technology-assisted learning techniques were generally much utilized ($\bar{x}$ = 3.68), with visualization and conceptual understanding emerging as the most dominant dimension, followed by engagement and data-driven instruction. Immediate feedback was the least utilized, indicating a relative gap in real-time assessment practices. In terms of effectiveness, the techniques were found to be much effective ($\bar{x}$ = 3.68), particularly in enhancing learners' comprehension and evaluation skills. However, effectiveness in knowledge acquisition, analysis, and application remained at a moderate level, suggesting uneven impact across cognitive domains. Statistical analysis further showed a significant agreement among teachers regarding both the utilization and effectiveness of technology-assisted learning techniques, except for the knowledge domain, where consensus was not established. This indicates variability in how foundational knowledge is influenced by technological integration compared to higher-order thinking skills. The study concludes that while technology-assisted learning significantly enhances Mathematics instruction, particularly in higher-order cognitive skills, its full potential remains underutilized in foundational learning and real-time feedback systems. It recommends strengthened teacher training, improved ICT infrastructure, and the systematic integration of advanced digital tools to optimize learning outcomes.

1. Introduction

The integration of technology in education has transformed traditional teaching and learning paradigms, particularly in foundational subjects such as Mathematics. With the increasing availability of digital tools, educators are now equipped with innovative strategies that promote engagement, interactivity, and individualized learning experiences. Technology-assisted learning has become a critical component in addressing diverse learner needs and enhancing instructional delivery in contemporary classrooms.

Mathematics education, especially at the elementary level, presents persistent challenges related to learner comprehension, engagement, and retention. Traditional teaching methods often fail to address varying learning styles and cognitive readiness among learners. As such, the incorporation of technology-assisted techniques offers promising opportunities to bridge these gaps by providing visual, interactive, and adaptive learning environments.

In the Philippine educational context, the Department of Education has continuously emphasized the integration of information and communication technology (ICT) in teaching and learning processes. This initiative aligns with global trends in education, where digital literacy and technology integration are considered essential competencies for both teachers and learners. However, the extent to which these technologies are effectively utilized and their impact on learning outcomes remain areas that require empirical investigation.

Technology-assisted learning techniques encompass a wide range of tools and strategies, including digital simulations, interactive applications, online assessments, and data-driven instructional platforms. These techniques are designed to enhance learner engagement, facilitate personalized instruction, and provide immediate feedback. Moreover, they enable teachers to monitor learner progress and adjust instructional strategies based on real-time data.

Despite these advancements, disparities in the utilization and effectiveness of technology-assisted learning persist across different educational settings. Factors such as access to resources, teacher competence, and institutional support influence the degree to which technology is integrated into classroom instruction. Consequently, understanding these variations is crucial in developing targeted interventions and policies that support effective technology integration.

The present study focuses on the Capalonga District in the Division of Camarines Norte, where efforts to integrate technology in elementary education are ongoing. By examining the practices of Grade 3 teachers, this research provides insights into how technology-assisted learning techniques are implemented in real classroom settings and how they influence learners' academic performance in Mathematics.

Specifically, the study investigates the extent of utilization of technology-assisted learning techniques across five key dimensions: engagement, personalized learning, visualization and conceptual understanding, immediate feedback, and data-driven instruction. These dimensions reflect the multifaceted nature of technology integration and its potential to enhance various aspects of the teaching-learning process.

Furthermore, the study evaluates the effectiveness of these techniques in improving learners' academic performance across five cognitive domains: knowledge, comprehension, analysis, application, and evaluation. This framework aligns with established educational taxonomies, emphasizing the progression from basic recall to higher-order thinking skills.

An important aspect of this research is the examination of the degree of agreement among teachers regarding the utilization and effectiveness of technology-assisted learning techniques. Through the use of Kendall's Coefficient of Concordance, the study provides a statistical basis for understanding the consistency of instructional practices across different school contexts.

Ultimately, this study contributes to the growing body of literature on educational technology by providing empirical evidence on its role in enhancing Mathematics education at the elementary level. The findings are expected to inform policy development, instructional planning, and professional development initiatives aimed at maximizing the benefits of technology-assisted learning in improving academic outcomes.

2. Methodology

This study employed a descriptive–evaluative–correlational research design to systematically examine the effectiveness of technology-assisted learning techniques in improving the academic performance of Grade 3 learners in Mathematics. The descriptive component enabled the researcher to characterize the extent of utilization of technology-assisted learning techniques across key instructional dimensions, while the evaluative aspect assessed their effectiveness in enhancing learners' cognitive outcomes. The correlational component, on the other hand, was utilized to determine the degree of agreement among teachers regarding both utilization and effectiveness using non-parametric statistical measures. This multi-dimensional design was deemed appropriate as it allowed for a comprehensive analysis of both instructional practices and their perceived outcomes within real classroom contexts.

The study was conducted in the Capalonga District, Division of Camarines Norte, a locale characterized by a mix of big, medium, and small public elementary schools. This setting provided a heterogeneous educational environment that enabled comparative insights across different school typologies. The district was purposively selected due to its active implementation of technology-assisted instructional strategies in response to evolving educational demands. The inclusion of varied school categories ensured that the findings captured differences in access to technological resources, instructional practices, and institutional support systems.

The respondents of the study consisted of thirty-six (36) Grade 3 teachers, selected through total enumeration sampling. This approach ensured that all eligible teachers within the district were included, thereby eliminating sampling bias and enhancing the representativeness of the data. The respondents were directly involved in the implementation of Mathematics instruction and the integration of technology-assisted learning techniques, making them the most appropriate sources of data. Their teaching experiences, exposure to digital tools, and classroom practices provided a reliable basis for evaluating both utilization and effectiveness.

The primary data collection instrument used in this study was a structured questionnaire designed to measure two major constructs: (1) the extent of utilization of technology-assisted learning techniques and (2) the extent of their effectiveness in improving learners' academic performance. The instrument was divided into two main sections. The first section assessed utilization across five dimensions: engagement, personalized learning, visualization and conceptual understanding, immediate feedback, and data-driven instruction. The second section measured effectiveness across five cognitive domains: knowledge, comprehension, analysis, application, and evaluation. Each indicator was rated using a five-point Likert scale, with corresponding descriptive interpretations ranging from "Not at All" to "Very Much Utilized/Effective."

To ensure the validity and reliability of the instrument, it underwent content validation by subject matter experts in education and research. Suggestions from validators were incorporated to refine item clarity, relevance, and alignment with the study objectives. Furthermore, the instrument was subjected to reliability testing using appropriate statistical measures to ensure internal consistency. These procedures guaranteed that the instrument accurately captured the constructs being measured and produced dependable results for analysis.

Data gathering followed a systematic procedure beginning with securing permission from relevant educational authorities, including district supervisors and school heads. Upon approval, the researcher personally administered the questionnaires to the respondents to ensure clarity of instructions and completeness of responses. Ethical considerations were strictly observed throughout the process, including voluntary participation, confidentiality of responses, and the assurance that data would be used solely for research purposes. The collected data were carefully checked, coded, and organized for statistical analysis.

The data were analyzed using both descriptive and inferential statistical tools. The weighted mean was used to determine the extent of utilization and effectiveness of technology-assisted learning techniques, while ranking was employed to establish the order of importance of indicators within each dimension. These descriptive measures provided a clear quantitative description of instructional practices and their outcomes.

To test the degree of agreement among respondents, the study utilized the Kendall Coefficient of Concordance (W), a non-parametric statistic suitable for assessing consensus among raters. The corresponding chi-square test was computed to determine the statistical significance of the observed agreement. This approach was particularly appropriate given the ordinal nature of the data and the need to evaluate consistency across multiple respondents and school categories. The level of significance was set at 0.05, serving as the basis for accepting or rejecting the null hypothesis.

The analytical framework of the study was anchored on the examination of both instructional inputs and learning outcomes. The utilization of technology-assisted learning techniques represented the instructional input, while the effectiveness across cognitive domains represented the learning outcomes. By integrating these variables, the study was able to establish a comprehensive understanding of how instructional practices influence academic performance in Mathematics.

Overall, the methodological approach ensured rigor, reliability, and validity in examining the role of technology-assisted learning techniques in elementary Mathematics education. The combination of descriptive, evaluative, and correlational analyses provided a robust basis for drawing meaningful conclusions and formulating evidence-based policy recommendations aimed at enhancing instructional practices and learner outcomes.

3. Results and Discussions

This section presents the analyzed data on the utilization and effectiveness of technology-assisted learning techniques and provides an in-depth interpretation of their implications for Mathematics instruction among Grade 3 learners.

3.1 Extent of the Utilization of Technology-Assisted Learning Techniques

Table 1. Summary of the Extent of Utilization of Technology-Assisted Learning Techniques

Dimension	Weighted Mean	Interpretation	Rank
Visualization & Conceptual Understanding	4.02	Much Utilized	1
Engagement	3.80	Much Utilized	2
Data-Driven Instruction	3.75	Much Utilized	3
Personalized Learning	3.60	Much Utilized	4
Immediate Feedback	3.24	Utilized	5
Overall Mean	3.68	Much Utilized	—

The data reveal that technology-assisted learning techniques are generally much utilized, with an overall weighted mean of 3.68, indicating that teachers have already integrated digital tools into their instructional practices at a functional level. However, the variation across dimensions suggests uneven adoption patterns, where certain pedagogical applications of technology are prioritized over others.

A closer examination shows that visualization and conceptual understanding (4.02) ranked highest, reflecting teachers' strong reliance on visual tools such as video tutorials, digital diagrams, and simulations. This indicates that technology is primarily used to simplify abstract mathematical concepts, making them more accessible to young learners. This finding underscores the pedagogical value of multimedia tools in bridging cognitive gaps, particularly in Mathematics where abstract reasoning is required. However, this dominance also implies a possible over-reliance on visualization at the expense of other instructional dimensions such as feedback and personalization.

Engagement (3.80) emerged as the second most utilized dimension, suggesting that teachers actively employ interactive tools such as quizzes, gamification, and digital storytelling to sustain learner interest. This indicates a shift toward learner-centered approaches where motivation and participation are enhanced through technology. Nevertheless, while engagement strategies are widely implemented, their effectiveness depends on alignment with learning objectives. High engagement does not necessarily equate to deep learning, and without structured scaffolding, these strategies may remain surface-level interventions.

Data-driven instruction (3.75) ranked third, indicating that teachers are beginning to incorporate analytics and digital monitoring tools in their teaching practices. The use of dashboards, LMS tracking, and assessment analytics suggests a growing awareness of evidence-based instruction. However, the relatively moderate score implies that teachers are still operating at a basic level of data utilization, primarily descriptive rather than predictive or diagnostic. This highlights a critical gap in advanced data literacy, where teachers may need further training to fully leverage analytics for instructional decision-making.

Personalized learning (3.60), although categorized as much utilized, reflects a transitional stage in instructional practice. Teachers are employing differentiated tasks and self-paced modules, yet the lower ranking indicates limited use of advanced adaptive technologies such as AI-driven platforms. This suggests that personalization remains largely teacher-directed rather than system-driven, which may constrain its scalability and effectiveness. The findings imply that while teachers recognize the importance of individualized instruction, structural and technical limitations hinder full implementation.

The lowest-ranked dimension, immediate feedback (3.24), reveals a critical weakness in the integration of technology-assisted learning. Despite the availability of digital tools that enable real-time feedback, their utilization remains limited. This has significant pedagogical implications, as timely feedback is essential for reinforcing learning and correcting misconceptions. The underutilization of feedback mechanisms suggests that learners may not be receiving sufficient formative assessment to support continuous improvement.

3.2 Test of Significant Agreement on Utilization

Table 2. Kendall's Coefficient of Concordance on Utilization

Dimension	Kendall's W	Chi-Square	p-value	Decision
Engagement	0.94	31.02	<0.001	Reject H_0
Personalized Learning	0.82	29.52	<0.005	Reject H_0
Conceptual Understanding	0.86	30.96	<0.005	Reject H_0
Immediate Feedback	0.84	25.20	<0.005	Reject H_0
Data-Driven Instruction	0.67	18.19	<0.05	Reject H_0

The results indicate a significant agreement among teachers regarding the utilization of technology-assisted learning techniques across all dimensions. The high Kendall's W values, particularly for engagement (0.94) and conceptual understanding (0.86), demonstrate strong consistency in instructional practices across different school types.

This high level of agreement suggests that technology integration is not sporadic but rather institutionalized within the district. Teachers exhibit shared pedagogical approaches, likely influenced by common training programs, curriculum standards, and administrative directives. However, such uniformity may also indicate limited innovation, where teachers rely on similar tools and strategies rather than exploring diverse or advanced technologies.

3.3 Extent of Effectiveness on Academic Performance

Table 3. Summary of Effectiveness Across Cognitive Domains

Domain	Weighted Mean	Interpretation	Rank
Comprehension	4.38	Much Effective	1
Evaluation	3.91	Much Effective	2
Analysis	3.43	Effective	3
Application	3.37	Effective	4
Knowledge	3.31	Effective	5
Overall Mean	3.68	Much Effective	—

The findings reveal that technology-assisted learning techniques are generally much effective, particularly in enhancing higher-order cognitive skills. The highest rating in comprehension (4.38) indicates that digital tools are highly effective in helping learners understand mathematical concepts. This can be attributed to the use of visual and interactive resources that make abstract ideas more concrete and relatable.

The strong performance in comprehension suggests that technology serves as a cognitive scaffold, enabling learners to process and internalize information more effectively. However, this also implies that comprehension gains are heavily dependent on visual and guided instruction, which may limit learners' ability to independently construct knowledge without technological support.

Evaluation (3.91) ranked second, indicating that technology effectively supports self-assessment and reflective learning. Tools such as digital rubrics, automated feedback systems, and performance tracking enable learners to monitor their progress and identify areas for improvement. This highlights the role of technology in fostering metacognitive skills, which are essential for lifelong learning.

Despite these strengths, the lower ratings in analysis (3.43) and application (3.37) suggest that technology is less effective in promoting deeper cognitive engagement. While learners can understand concepts, they may struggle to apply them in new contexts or analyze complex problems. This indicates a gap between conceptual understanding and practical application, which may stem from the limited use of problem-based and inquiry-driven digital tools.

The lowest rating in knowledge (3.31) is particularly significant, as it suggests that technology has a weaker impact on foundational learning. This may be due to the fact that basic knowledge acquisition relies more on repetition and memorization, which are not always effectively supported by digital tools. Alternatively, it may reflect inconsistencies in how teachers use technology for foundational instruction.

3.4 Test of Significant Agreement on Effectiveness

Table 4. Kendall's Coefficient of Concordance on Effectiveness

Domain	Kendall's W	Chi-Square	p-value	Decision
Knowledge	0.59	17.70	>0.05	Accept H_0
Comprehension	0.89	26.70	<0.005	Reject H_0
Analysis	0.96	31.68	<0.001	Reject H_0
Application	0.95	28.50	<0.005	Reject H_0
Evaluation	0.89	29.37	<0.005	Reject H_0

The results indicate a significant agreement among teachers on the effectiveness of technology-assisted learning techniques across most cognitive domains, except for knowledge.

The lack of agreement in the knowledge domain suggests variability in how teachers perceive the role of technology in foundational learning. This inconsistency may be attributed to differences in instructional strategies, resource availability, or teacher competence in using digital tools for basic skill development. It also highlights a critical limitation of technology-assisted learning, where its impact is more pronounced in higher-order thinking than in foundational knowledge acquisition.

Conversely, the strong agreement in comprehension, analysis, application, and evaluation indicates that teachers consistently recognize the value of technology in enhancing complex cognitive processes. This reinforces the notion that technology is most effective when used to support interactive, inquiry-based, and reflective learning experiences.

Overall, the results demonstrate that technology-assisted learning techniques are both widely utilized and generally effective, particularly in enhancing higher-order cognitive skills. However, the findings also reveal critical gaps in immediate feedback, foundational knowledge acquisition, and advanced data-driven instruction.

These results suggest that while technology has transformed instructional practices, its integration remains uneven and requires strategic enhancement. For technology-assisted learning to achieve its full potential, there must be a deliberate effort to strengthen underutilized areas, particularly feedback mechanisms and foundational instruction, while also advancing teachers' competencies in using sophisticated digital tools.

5. Conclusions and Implications

4.1 Conclusions

The findings of the study lead to the conclusion that technology-assisted learning techniques are already embedded in Mathematics instruction among Grade 3 teachers, as evidenced by their overall classification as "much utilized." This indicates that teachers have moved beyond initial adoption and are now operating at a functional level of technology integration. However, the uneven distribution across dimensions—particularly the lower utilization of immediate feedback mechanisms—demonstrates that integration is not yet holistic and remains selective in practice.

It can be concluded that teachers predominantly use technology to enhance visualization and engagement, suggesting that digital tools are primarily leveraged to simplify abstract concepts and maintain learner interest. While this supports comprehension, it also reflects a tendency toward surface-level integration, where technology is used as a supplementary tool rather than as a transformative instructional mechanism. Consequently, the full pedagogical potential of technology remains underutilized, particularly in fostering deeper, data-driven, and feedback-oriented learning environments.

The study further concludes that technology-assisted learning techniques are generally effective in improving academic performance, particularly in higher-order cognitive domains such as comprehension and evaluation. This affirms the capacity of digital tools to facilitate conceptual understanding and reflective thinking. However, the relatively lower effectiveness in knowledge acquisition, analysis, and application suggests that technology does not uniformly support all levels of cognitive development. This disparity indicates that while technology enhances understanding, it does not automatically translate into mastery of foundational skills or the ability to transfer knowledge across contexts.

Another key conclusion is the presence of significant agreement among teachers regarding both utilization and effectiveness of technology-assisted learning techniques, except in the domain of knowledge. This high level of concordance reflects a shared instructional culture and consistent pedagogical practices across schools. However, the lack of agreement in foundational knowledge suggests variability in instructional approaches and highlights a critical area where technology integration is least stable and most contested.

Finally, the study concludes that the effectiveness of technology-assisted learning is contingent upon the level of teacher competence, availability of resources, and the strategic alignment of digital tools with instructional objectives. While technology has demonstrated its value as a facilitator of learning, its impact is mediated by how it is implemented. Without systematic training, infrastructure support, and pedagogical alignment, technology integration risks remaining fragmented and suboptimal.

4.2 Implications

The results of the study carry significant implications for educational policy, instructional practice, and research in the field of technology integration in basic education. At the policy level, the findings imply the need for a more structured and systemic approach to ICT integration, moving beyond access and availability toward strategic utilization. Educational authorities must prioritize policies that institutionalize the use of technology not only for engagement and visualization but also for feedback, personalization, and data-driven instruction. This includes the development of standardized frameworks for technology integration aligned with curriculum competencies and learning outcomes.

From an instructional perspective, the findings suggest that teachers require continuous professional development focused on advanced pedagogical uses of technology. Training programs should go beyond basic tool usage and emphasize instructional design, data analytics, and real-time assessment strategies. The underutilization of immediate feedback mechanisms and advanced technologies such as AI-driven tools highlights a critical gap in teacher capacity, which must be addressed to maximize the instructional benefits of technology-assisted learning.

The study also implies that schools must invest in robust ICT infrastructure to support effective implementation. Reliable internet connectivity, access to devices, and technical support systems are essential for sustaining technology integration. Without these foundational resources, even the most well-designed instructional strategies cannot be effectively executed. The disparities observed in the utilization of advanced tools suggest that resource limitations continue to constrain innovation in classroom practices.

In terms of curriculum development, the findings indicate the need to embed technology-assisted learning more explicitly within instructional frameworks. Learning modules, lesson exemplars, and assessment strategies should integrate digital tools in a way that promotes higher-order thinking skills while also reinforcing foundational knowledge. The observed gap in knowledge acquisition suggests that technology must be intentionally designed to support both basic and complex learning processes.

The implications also extend to learner outcomes, particularly in fostering independent and self-regulated learning. The strong effectiveness of technology in enhancing evaluation skills suggests that learners are capable of engaging in reflective practices when supported by appropriate digital tools. This highlights the potential of technology to develop metacognitive skills, which are essential for lifelong learning. However, this potential can only be realized if learners are guided in the purposeful use of technology rather than passive consumption.

Finally, the study implies the need for further research on the differential impact of specific technologies on various cognitive domains. The lack of consensus in the knowledge domain suggests that not all digital tools are equally effective for all types of learning. Future studies should explore which technologies are most appropriate for foundational learning and how they can be integrated with higher-order instructional strategies. Such research will contribute to a more nuanced understanding of technology-assisted learning and support evidence-based decision-making in education.

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