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The Effectiveness of the Integration of Technology in Enhancing The Grade 2 Learners' Performance in Mathematics in Capalonga District, Division of Camarines Norte

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ABSTRACT

This study examined the effectiveness of the integration of technology in enhancing the academic performance of Grade 2 learners in Mathematics in Capalonga District, Division of Camarines Norte, during the School Year 2024–2025. It specifically analyzed the extent to which technology is integrated in instructional processes, including giving motivation, presenting the lesson, discussing the lesson, assessing learning outcomes, and providing reinforcement, as well as its effectiveness across cognitive domains such as knowledge, understanding, analysis, application, and evaluation. Anchored on a descriptive–evaluative–correlational research design, the study utilized total enumeration of Mathematics teachers in the district. Data were collected through a structured questionnaire and 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, ensuring statistical rigor in testing the hypotheses. Findings revealed that the integration of technology in Mathematics instruction is very much evident, with an overall mean of 4.69. Among the instructional dimensions, giving motivation ranked highest, followed by presenting the lesson and discussing the lesson, while providing reinforcement ranked lowest, although still within the "very much evident" category. This indicates that teachers extensively utilize technology to stimulate learner engagement and facilitate lesson delivery. In terms of effectiveness, technology integration was found to be much effective, with an overall mean of 4.41. The highest effectiveness was observed in the knowledge domain, followed by understanding and application, while evaluation obtained the lowest mean. This suggests that technology plays a significant role in enhancing foundational learning and conceptual understanding, although its impact on higher-order thinking skills is comparatively moderate. The test of significant agreement revealed that there was no significant agreement among teachers regarding both the extent of integration and its effectiveness across all indicators. This indicates variability in instructional practices and perceptions among respondents, suggesting that technology integration is influenced by contextual factors such as teacher competence, resource availability, and school conditions. The study concludes that while technology integration in Mathematics instruction is highly evident and generally effective, its implementation remains inconsistent across teachers and dimensions. It recommends strengthening teacher training, enhancing access to digital tools, and institutionalizing structured technology integration frameworks to ensure more uniform and impactful instructional practices.

1. Introduction

The integration of technology in education has become a defining feature of contemporary teaching and learning environments, particularly in foundational subjects such as Mathematics. Advances in digital tools and instructional technologies have enabled educators to transform traditional pedagogical approaches into more interactive, engaging, and learner-centered experiences. As educational systems continue to evolve, the role of technology in enhancing academic performance has become increasingly significant.

Mathematics, as a core subject in the basic education curriculum, plays a crucial role in developing learners' logical reasoning, problem-solving skills, and analytical thinking. However, many learners encounter difficulties in understanding abstract mathematical concepts, which often leads to low performance and negative attitudes toward the subject. These challenges necessitate the adoption of innovative instructional strategies that can effectively address diverse learning needs and improve learner outcomes.

Technology integration offers a promising solution to these challenges by providing dynamic and interactive learning environments. Tools such as multimedia presentations, simulations, gamified applications, and adaptive learning platforms enable teachers to present complex concepts in more accessible and engaging ways. These technologies also support differentiated instruction, allowing learners to progress at their own pace and according to their individual learning styles.

In the Philippine educational context, the Department of Education has emphasized the importance of integrating information and communication technology (ICT) in teaching and learning processes. This initiative is aligned with global educational trends that recognize digital literacy as an essential competency for both teachers and learners. However, despite these efforts, the extent and effectiveness of technology integration in actual classroom settings remain varied and require systematic evaluation.

The effectiveness of technology integration is not solely determined by the availability of digital tools but also by how these tools are utilized in instructional practices. Effective integration involves the alignment of technology with pedagogical objectives, content delivery, and assessment strategies. It also requires teachers to possess the necessary skills and competencies to maximize the potential of technology in enhancing learning outcomes.

This study focuses on the Capalonga District in the Division of Camarines Norte, where efforts to integrate technology in elementary education are actively implemented. By examining the practices of Grade 2 teachers, the study provides empirical insights into how technology is utilized in real classroom settings and how it influences learners' performance in Mathematics.

Specifically, the study investigates the extent of technology integration across five instructional dimensions: giving motivation, presenting the lesson, discussing the lesson, assessing learning outcomes, and providing reinforcement. These dimensions reflect the comprehensive role of technology in supporting various stages of the teaching-learning process, from engaging learners to reinforcing acquired knowledge.

Furthermore, the study evaluates the effectiveness of technology integration in enhancing learners' academic performance across five cognitive domains: knowledge, understanding, analysis, application, and evaluation. This framework is grounded in established educational taxonomies, which emphasize the progression of learning from basic knowledge acquisition to higher-order thinking skills.

An important aspect of this research is the examination of the degree of agreement among teachers regarding the integration and effectiveness of technology. By employing Kendall's Coefficient of Concordance, the study provides a statistical basis for understanding the consistency of teachers' perceptions and practices across different school contexts.

Ultimately, this study contributes to the growing body of literature on educational technology by providing evidence-based insights into its role in enhancing Mathematics instruction at the elementary level. The findings are expected to inform policy development, instructional planning, and professional development initiatives aimed at optimizing the integration of technology to improve academic performance and overall learning outcomes.

2. Methodology

This study employed a descriptive–evaluative–correlational research design to determine the effectiveness of the integration of technology in enhancing the academic performance of Grade 2 learners in Mathematics. The descriptive component was utilized to determine the extent of technology integration across various instructional dimensions, while the evaluative aspect assessed its effectiveness in improving learners' cognitive performance. The correlational component, specifically through the use of Kendall's Coefficient of Concordance, was applied to determine the degree of agreement among teachers regarding both the extent of integration and its effectiveness. This comprehensive research design allowed for a systematic examination of both instructional practices and their perceived outcomes within authentic classroom settings.

The study was conducted in the Capalonga District, Division of Camarines Norte, which consists of public elementary schools categorized as big, medium, and small institutions. The selection of this locale was based on purposive sampling, considering its active implementation of technology-assisted instruction in Mathematics and its representativeness of varied school contexts. This diversity in school classification provided a meaningful basis for analyzing variations in technology integration practices and instructional effectiveness across different educational environments.

The respondents of the study were Grade 2 Mathematics teachers from the identified public elementary schools within the district. A total enumeration sampling technique was employed, wherein all teachers handling Mathematics 2 were included as respondents. This approach ensured comprehensive data coverage and minimized sampling bias, thereby enhancing the validity and generalizability of the findings within the district context. The teachers were selected based on their direct involvement in instructional delivery and their experience in integrating technology into their teaching practices.

The primary instrument used in data collection was a structured questionnaire designed to measure two key constructs: (1) the extent of the integration of technology in enhancing learners' performance and (2) the extent of its effectiveness across cognitive domains. The instrument was divided into two major sections. The first section measured the extent of integration along five dimensions: giving motivation, presenting the lesson, discussing the lesson, assessing learning outcomes, and providing reinforcement. The second section assessed effectiveness across five domains: knowledge, understanding, analysis, application, and evaluation. Each indicator was rated using a five-point Likert scale, with corresponding interpretations ranging from "Not at All Evident" to "Very Much Evident" and from "Not Effective" to "Very Much Effective."

To ensure the validity of the instrument, it underwent content validation by experts in education, research, and statistics. The validators reviewed the questionnaire for clarity, relevance, and alignment with the objectives of the study. Necessary revisions were made based on their recommendations to improve the quality of the instrument. In addition, reliability testing was conducted to ensure the consistency of the responses, thereby establishing the instrument's suitability for data collection. These procedures ensured that the instrument accurately captured the constructs under investigation.

The data gathering procedure followed a systematic and ethical process. Permission to conduct the study was secured from the appropriate educational authorities, including the Public Schools District Supervisor and school heads. The researcher personally administered the questionnaires to the respondents to ensure proper orientation and to clarify any ambiguities in the instrument. Respondents were assured of the confidentiality and anonymity of their responses, and participation was strictly voluntary. After retrieval, the questionnaires were checked for completeness, coded, and organized for statistical analysis.

The collected data were analyzed using both descriptive and inferential statistical tools. The weighted mean was used to determine the extent of the integration of technology and its effectiveness, while ranking was employed to establish the relative importance of each indicator within the different dimensions. These descriptive statistics provided a clear quantitative representation of teachers' perceptions and practices regarding technology integration.

To determine the degree of agreement among respondents, the study utilized the Kendall Coefficient of Concordance (W), a non-parametric statistical measure appropriate for assessing consensus among multiple raters. The corresponding chi-square test (χ^2) was computed to determine the statistical significance of the observed agreement. The computed chi-square values were compared with the tabular values at a 0.05 level of significance to test the null hypothesis. This approach ensured a rigorous examination of the consistency of responses across different groups of respondents.

The analytical framework of the study was anchored on the relationship between technology integration as the instructional input and learners' academic performance as the output, operationalized through cognitive domains. By examining both the extent of integration and its effectiveness, the study was able to provide a comprehensive understanding of how technology influences teaching practices and learning outcomes in Mathematics.

3. Results and Discussions

This section presents the findings on the extent of technology integration and its effectiveness in enhancing Grade 2 learners' performance in Mathematics, followed by comprehensive analytical interpretations grounded on the data.

3.1 Extent of the Integration of Technology in Mathematics Instruction

Table 1. Summary of the Extent of Technology Integration

Dimension	Weighted Mean	Interpretation	Rank
Giving Motivation	4.77	Very Much Evident	1
Presenting the Lesson	4.75	Very Much Evident	2
Discussing the Lesson	4.71	Very Much Evident	3
Assessing Learning Outcomes	4.69	Very Much Evident	4
Providing Reinforcement	4.50	Very Much Evident	5
Overall Mean	4.69	Very Much Evident	—

The findings reveal that the integration of technology in Mathematics instruction is very much evident, with an overall mean of 4.69, indicating a high level of adoption among teachers. This suggests that technology is no longer supplementary but has become an integral component of instructional delivery. However, despite this high level of integration, the variation in rankings across dimensions indicates that teachers prioritize certain instructional functions over others when utilizing technology.

The highest-ranked dimension, giving motivation (4.77), demonstrates that teachers extensively use technology to capture learners' interest and sustain engagement. The use of gamification, multimedia content, and interactive tools reflects a shift toward affective-driven instruction, where motivation is considered a prerequisite for learning. This implies that technology is effectively addressing one of the major barriers in Mathematics education—learner disengagement and anxiety. However, the emphasis on motivation may also suggest that technology is being used more as an engagement tool rather than a deep learning mechanism, which may limit its impact on higher-order cognitive development.

Presenting the lesson (4.75) ranked second, indicating that teachers heavily rely on digital tools such as presentations, simulations, and visual aids to deliver content. This highlights the role of technology in enhancing clarity and organization in instruction. The ability of digital tools to break down complex concepts into manageable segments significantly improves learners' comprehension. However, this reliance on structured presentation may also indicate a teacher-centered approach, where technology is used primarily to transmit knowledge rather than facilitate active learner construction of meaning.

The dimension of discussing the lesson (4.71) further emphasizes the role of technology in promoting interaction and collaboration. The use of digital platforms for discussions, real-time feedback, and collaborative problem-solving suggests that teachers are beginning to adopt more interactive instructional strategies. This supports the development of communication and reasoning skills among learners. Nevertheless, the effectiveness of such interactions depends on the depth of engagement and the quality of discourse, which may vary across classroom contexts.

Assessing learning outcomes (4.69) indicates that teachers are utilizing technology for formative and summative assessment practices. Digital tools such as online quizzes, analytics platforms, and automated grading systems provide immediate feedback and facilitate continuous monitoring of learner progress. This reflects a transition toward data-informed instruction. However, the slightly lower ranking compared to other dimensions suggests that assessment practices may not be fully optimized, particularly in leveraging advanced analytics for instructional decision-making.

The lowest-ranked dimension, providing reinforcement (4.50), although still very much evident, highlights a relative gap in the use of technology for sustained learning support. Reinforcement activities such as remedial exercises and independent practice are essential for mastery learning, yet their lower utilization suggests that technology is less frequently used beyond initial instruction. This indicates a need to strengthen the role of technology in supporting long-term retention and skill development.

3.2 Test of Significant Agreement on the Extent of Integration

Table 2. Kendall's Coefficient of Concordance on Integration

Dimension	Kendall's W	Chi-Square	Decision
Giving Motivation	0.34	9.18	Not Significant
Presenting the Lesson	0.12	3.24	Not Significant
Discussing the Lesson	0.55	14.85	Not Significant
Assessing Learning Outcomes	0.56	15.12	Not Significant
Providing Reinforcement	0.59	15.93	Not Significant

The results indicate that there is no significant agreement among teachers regarding the extent of technology integration across all dimensions. This lack of consensus suggests variability in how teachers implement technology in their instructional practices.

This variability may be attributed to differences in access to resources, teacher competence, and institutional support. While some teachers may effectively integrate advanced digital tools, others may rely on basic technologies, resulting in inconsistent practices across schools. This finding highlights a critical challenge in technology integration—ensuring uniformity and standardization in its implementation.

3.3 Extent of Effectiveness on Learners' Performance

Table 3. Summary of Effectiveness Across Cognitive Domains

Domain	Weighted Mean	Interpretation	Rank
Knowledge	4.56	Very Much Effective	1
Understanding	4.43	Much Effective	2
Application	4.40	Much Effective	3
Analysis	4.35	Much Effective	4
Evaluation	4.29	Much Effective	5
Overall Mean	4.41	Much Effective	—

The findings show that technology integration is much effective in enhancing learners' academic performance, with an overall mean of 4.41. The highest effectiveness was observed in the knowledge domain (4.56), indicating that technology is particularly effective in supporting foundational learning and recall of mathematical concepts.

The strong performance in knowledge suggests that digital tools such as quizzes, videos, and interactive content facilitate memory retention and understanding of basic concepts. However, this also implies that technology is primarily used for lower-order cognitive processes, which may limit its potential to foster deeper learning.

The domain of understanding (4.43) further demonstrates the effectiveness of technology in enhancing conceptual clarity. Tools such as simulations, visualizations, and real-life examples enable learners to grasp relationships between concepts. This indicates that technology serves as a cognitive scaffold, supporting learners in constructing meaning from abstract mathematical ideas.

Despite these strengths, the lower ratings in analysis (4.35) and application (4.40) suggest that technology is less effective in promoting higher-order thinking skills. While learners can understand concepts, they may struggle to apply and analyze them in complex or unfamiliar contexts. This gap indicates that instructional practices may not fully leverage technology for inquiry-based and problem-solving activities.

The lowest rating in evaluation (4.29) highlights a limitation in fostering critical thinking and reflective learning. Evaluation requires learners to make judgments, justify solutions, and assess outcomes, which may not be adequately supported by current technology integration practices. This suggests a need to incorporate more advanced tools and strategies that promote higher-level cognitive engagement.

3.4 Test of Significant Agreement on Effectiveness

Table 4. Kendall's Coefficient of Concordance on Effectiveness

Domain	Kendall's W	Chi-Square	Decision
Knowledge	0.44	11.88	Not Significant
Understanding	0.43	11.61	Not Significant
Analysis	0.54	14.58	Not Significant
Application	0.16	4.32	Not Significant
Evaluation	0.50	13.50	Not Significant

The results indicate that there is no significant agreement among teachers regarding the effectiveness of technology integration across all cognitive domains.

This lack of consensus suggests that teachers have differing perceptions of how technology influences learning outcomes. These differences may stem from variations in teaching styles, levels of digital competence, and access to instructional resources. It also indicates that the impact of technology is not uniformly experienced across classrooms, highlighting the need for more standardized and evidence-based approaches to technology integration.

Overall, the findings demonstrate that technology integration in Mathematics instruction is highly evident and generally effective, particularly in enhancing learner motivation and foundational knowledge. However, the results also reveal critical gaps in higher-order cognitive development and consistency of implementation.

The absence of significant agreement across both integration and effectiveness underscores the need for systemic interventions, including teacher training, infrastructure development, and policy standardization. For technology to achieve its full potential in education, it must be strategically integrated across all instructional dimensions and cognitive domains, ensuring both depth and consistency in its application.

4. Conclusions and Implications

4.1 Conclusions

The findings of the study lead to the conclusion that the integration of technology in Mathematics instruction among Grade 2 learners is highly evident, indicating that teachers have already institutionalized the use of digital tools across major instructional processes. Technology is most prominently utilized in motivating learners and presenting lessons, demonstrating that teachers recognize its value in enhancing engagement and facilitating the delivery of abstract mathematical concepts. However, despite this strong integration, the relatively lower emphasis on reinforcement suggests that technology is not yet maximized in supporting sustained learning and mastery beyond initial instruction.

The study further concludes that technology integration is generally effective in enhancing learners' academic performance, particularly in the domain of knowledge acquisition. This indicates that digital tools are highly efficient in supporting foundational learning, improving recall, and strengthening conceptual understanding. However, the decreasing level of effectiveness observed in higher-order cognitive domains such as analysis, application, and evaluation suggests that technology is not fully utilized to promote deeper cognitive engagement. This implies that while learners benefit from technology in understanding concepts, they may not be sufficiently challenged to apply, analyze, and evaluate these concepts in more complex contexts.

Another critical conclusion is the absence of significant agreement among teachers regarding both the extent of integration and its effectiveness. This lack of consensus indicates variability in instructional practices, resource utilization, and teacher competencies across schools. It suggests that technology integration is influenced by contextual factors such as access to digital tools, training opportunities, and institutional support. Consequently, the implementation of technology in instruction remains uneven, which may limit its overall impact on learner outcomes.

Finally, the study concludes that the effectiveness of technology integration is not solely dependent on the availability of technological resources but on how these resources are pedagogically utilized. The alignment of technology with instructional objectives, teaching strategies, and assessment practices is crucial in determining its impact on learning. Without a structured and strategic approach, technology integration may remain superficial and fail to achieve its transformative potential in education.

4.2 Implications

The results of the study carry significant implications for educational policy, instructional practice, and future research in the field of technology integration. At the policy level, the findings highlight the need for a more systematic and standardized framework for technology integration in Mathematics instruction. Educational authorities must move beyond promoting access to digital tools and focus on ensuring their effective and consistent use across schools. This includes the development of clear guidelines, monitoring mechanisms, and performance indicators that align technology integration with curriculum standards and learning outcomes.

From an instructional perspective, the study implies that teachers require continuous and targeted professional development to enhance their capacity to integrate technology effectively. Training programs should emphasize not only technical skills but also pedagogical strategies that promote higher-order thinking, such as problem-based learning, inquiry-based instruction, and the use of digital tools for analysis and evaluation. Strengthening teacher competence is essential to bridging the gap between technology use and meaningful learning outcomes.

The findings also underscore the importance of strengthening ICT infrastructure and resource allocation in schools. While technology integration is evident, disparities in implementation suggest that not all teachers have equal access to advanced tools and platforms. Investments in reliable internet connectivity, updated devices, and technical support systems are necessary to ensure equitable and sustainable technology integration across different school contexts.

In terms of curriculum and assessment, the study implies that technology should be more intentionally embedded in instructional design to support both foundational and higher-order cognitive skills. Educators must ensure that digital tools are not limited to content delivery and engagement but are also used to facilitate critical thinking, problem-solving, and reflective learning. This requires the integration of technology-driven assessment strategies that go beyond recall and comprehension to include analysis, application, and evaluation.

The findings further suggest that technology integration has the potential to promote learner-centered and self-directed learning, particularly through tools that provide immediate feedback and personalized learning experiences. However, this potential can only be realized if learners are guided in the effective use of these tools. Teachers must therefore play a crucial role in scaffolding learning experiences and ensuring that technology is used purposefully rather than passively.

Finally, the study implies the need for further research on the differential impact of specific technologies on various cognitive domains. The observed variation in effectiveness across domains indicates that not all technologies are equally suited for all types of learning. Future studies should explore which digital tools are most effective for developing higher-order thinking skills and how these can be integrated into classroom practices to maximize learning outcomes.

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