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The Effectiveness of the Strategies Employed by the Teachers in the Integration of the Technology-Based Learning Materials in Mathematics 6 in Calauag East District, Division of Quezon

Ginalyn M. Del Mundo[1]

[1]School of Graduate Studies, University of Northeastern Philippines

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ABSTRACT

Technology-based learning materials have become central to contemporary mathematics instruction because they expand the ways learners can visualize, manipulate, discuss, and apply mathematical ideas. This journal article examined the effectiveness of teachers' strategies in integrating technology-based learning materials in Mathematics 6 in Calauag East District, Division of Quezon, for School Year 2024-2025. It focused on integration strategies, perceived effectiveness across mathematical domains, teacher-reported implementation problems, and policy recommendations. The study was framed by the need to strengthen evidence-based digital pedagogy in elementary mathematics while recognizing the practical realities of school-level implementation. The inquiry was guided by a descriptive-evaluative-correlational design. Sixty-seven teacher-respondents from the district participated through total enumeration, while the study locale was selected purposively because of its relevance to the research problem. Data were analyzed using weighted mean, rank, Kendall's coefficient of concordance W, and the corresponding chi-square test at the 0.05 level of significance. These procedures allowed the study to describe the level of technology integration, evaluate perceived instructional effectiveness, and test whether respondents from different school types agreed in their rank ordering of indicators. Results showed that technology-based learning materials were much employed in Mathematics 6 instruction, with an overall weighted mean of 4.23. Among the five integration strategies, game-based learning obtained the highest mean of 4.33, followed by use of educational apps at 4.32 and multimedia-based learning at 4.29. Interactive whiteboards obtained a mean of 4.14, while online collaborative platforms obtained the lowest mean of 4.05, although both were still interpreted as much employed. These findings suggest that teachers actively used digital strategies, particularly those that support motivation, practice, visualization, and app-based reinforcement. The rank-order agreement test for integration strategies showed mixed results. Multimedia-based learning, game-based learning, interactive whiteboards, and educational apps did not show significant agreement across school types, as their chi-square values did not exceed the critical value at the 0.05 level. Online collaborative platforms, however, showed significant agreement with W = 0.98 and chi-square = 26.46, indicating stronger consistency in how respondents ranked this area. This pattern implies that some technology strategies were implemented with comparable emphasis across schools, while others varied according to infrastructure, teacher readiness, or classroom context. Technology-based learning materials were also perceived as much effective in teaching Mathematics 6, with an overall weighted mean of 4.25. Solving equations and expressions ranked first with a mean of 4.34, followed by measurement at 4.29, understanding fractions and decimals at 4.27, and geometry skills at 4.09. The results indicate that technology was especially useful for procedural visualization, simulation, guided practice, and interactive feedback. Even the lowest-ranked domain, geometry skills, remained within the much effective range, showing that digital tools contributed meaningfully across mathematical content areas. The rank-order agreement test for effectiveness also indicated differentiated patterns. Understanding fractions and decimals, solving equations and expressions, and measurement did not show significant agreement among the different school types. Geometry skills showed significant agreement with W = 0.76 and chi-square = 20.52, suggesting a more consistent ranking of geometry-related technology indicators. This finding points to the distinctive instructional demands of geometry, where visual, spatial, and manipulative digital tools may influence teacher perceptions more strongly than in other content areas. Teachers encountered serious problems in utilizing technology-based learning materials, with an overall weighted mean of 3.06. The most serious concerns were technical issues with educational apps or software during lessons and insufficient teacher training in effective curricular integration, both with means of 3.50. Classroom distraction, limited internet connectivity, limited digital devices, and difficulty identifying curriculum-aligned resources were also reported as notable barriers. These findings show that the effectiveness of technology integration depends not only on teacher willingness but also on infrastructure, support systems, professional development, and classroom management mechanisms. The rank-order agreement test for teacher-reported problems yielded W = 0.32 and chi-square = 8.64, which was not significant at the 0.05 level. This result indicates that school types did not share a uniform pattern in ranking implementation problems. Some schools may have been more affected by internet access, others by device availability, teacher training, classroom control, or technical support. Consequently, technology-integration policies should avoid a single uniform remedy and instead provide flexible, data-based support responsive to local school conditions. The findings support a policy direction that combines instructional innovation with implementation safeguards. Game-based learning, educational apps, multimedia resources, and interactive whiteboards should be strengthened because they showed high levels of use and perceived effectiveness. At the same time, online collaborative platforms, geometry-related technology use, teacher training, technical troubleshooting, and access to devices and connectivity require sustained attention. The proposed policy recommendations therefore emphasize standard lesson templates, quarterly workshops, app vetting, interactive whiteboard support, helpdesk mechanisms, professional learning communities, and digital-resource audits. The article concludes that technology-based learning materials were substantially integrated and perceived as instructionally effective in Mathematics 6 in Calauag East District. However, effectiveness was not automatic; it was mediated by teachers' capacity to select, align, facilitate, troubleshoot, and evaluate digital resources. The study contributes localized empirical evidence on the role of technology-based learning materials in elementary mathematics and offers actionable implications for school leaders, curriculum planners, teacher educators, and educational technology units.

1. Introduction

Mathematics education continues to occupy a strategic position in basic education because it develops reasoning, problem solving, abstraction, precision, and decision-making skills. In elementary education, the way mathematics is taught shapes learners' confidence toward numbers, patterns, space, and quantitative relationships. Grade-level mathematics becomes more meaningful when learners are not only exposed to formulas and procedures but are also given opportunities to observe, manipulate, discuss, and apply concepts. This requirement has intensified the need for instructional approaches that can translate abstract mathematical ideas into accessible learning experiences.

The growing presence of digital technologies in schools has altered the conditions under which mathematics is planned, delivered, practiced, and assessed. Technology-based learning materials now include multimedia presentations, digital games, online collaboration platforms, interactive whiteboards, educational applications, simulations, adaptive drills, and other electronic resources. These tools do not simply replace traditional materials; when used appropriately, they can extend teachers' capacity to present mathematical relationships dynamically. However, their value depends on purposeful pedagogical integration rather than mere availability or occasional use.

International discourse on educational technology emphasizes that digital tools must be relevant, equitable, scalable, and sustainable. UNESCO (2023) cautioned that technology in education should be judged according to whether it solves real educational problems and whether learners and teachers can use it meaningfully. In mathematics education, this caution is important because digital resources may either deepen conceptual understanding or become superficial add-ons. Therefore, examining how teachers employ technology-based learning materials provides insight into the actual instructional quality of digital transformation.

Research on technology in mathematics education generally supports the potential of digital tools to improve learning outcomes. Cheung and Slavin (2013) found that educational technology applications can enhance mathematics achievement in K-12 contexts when implemented with appropriate instructional design. Hillmayr et al. (2020) similarly reported positive effects of digital tools on mathematics and science learning, especially when tools are embedded in guided classroom activity. These findings suggest that effectiveness emerges from the interaction of technology, pedagogy, learner engagement, and content-specific instructional goals.

Recent reviews also show that digital technology in mathematics education is increasingly diverse and no longer limited to computer-assisted drills. Engelbrecht et al. (2024) described new developments such as blended learning, reconfigured learning spaces, digital making, and flexible interaction between learners and mathematical representations. Drijvers (2024) likewise noted that digital technologies serve multiple purposes, including visualization, exploration, feedback, communication, and assessment. These purposes correspond closely with elementary mathematics topics that require learners to move between concrete, pictorial, symbolic, and applied forms of understanding.

Among technology-based strategies, multimedia-based learning is especially relevant in elementary mathematics because it combines text, images, sound, animation, graphs, diagrams, and simulations. Multimedia can help learners perceive relationships that are difficult to explain through verbal instruction alone. For example, fractions, decimals, measurement conversions, and geometric transformations become more comprehensible when learners can see quantities, movements, and comparisons. Nevertheless, multimedia is most effective when teachers use it to guide thinking rather than to overload learners with disconnected visuals.

Game-based learning has also gained attention as a strategy for increasing motivation and active participation in mathematics. Digital games can provide immediate feedback, repetition, challenge, rewards, and contextualized practice. Vankúš (2021) reported that game-based learning in mathematics frequently influences affective outcomes such as motivation, engagement, attitude, enjoyment, and flow. Hussein et al. (2022) further emphasized that digital game-based learning has been perceived as promising in K-12 mathematics because it can promote interest and learning persistence.

Online collaborative platforms represent another dimension of technology integration because they allow learners to solve problems, share explanations, receive peer feedback, and work asynchronously or synchronously. These tools are valuable for mathematical communication, reasoning, and social construction of knowledge. In elementary classrooms, however, their effectiveness depends on digital access, task design, classroom routines, and teacher facilitation. Without clear mathematical purpose, online collaboration may become unfocused interaction rather than productive mathematical discourse.

Interactive whiteboards support whole-class visualization and shared manipulation of mathematical content. They can be used to draw, annotate, drag, classify, transform, solve, and review mathematical ideas in real time. In mathematics teaching, the interactive whiteboard is not merely a display device; it can function as a collective workspace where learners observe and participate in mathematical reasoning. Its effectiveness, however, depends on whether teachers use interactive features to deepen student participation instead of simply projecting static content.

Educational applications have become common tools for independent practice, formative assessment, adaptive learning, gamified reinforcement, progress tracking, and immediate feedback. Mathematics apps can personalize tasks, provide step-by-step guidance, and allow learners to practice beyond classroom time. Still, app integration requires careful selection because not all digital applications are aligned with curriculum standards, age appropriateness, or sound mathematical pedagogy. Teachers must therefore exercise professional judgment in matching apps with learning competencies and learner readiness.

Theoretical discussions on technology integration commonly emphasize the relationship among content knowledge, pedagogical knowledge, and technological knowledge. Mishra and Koehler’s (2006) technological pedagogical content knowledge framework argues that effective technology integration requires teachers to understand not only the tool but also how the tool reshapes teaching and learning of specific content. In Mathematics 6, this means that teachers must know which technology is appropriate for fractions, equations, measurement, or geometry. Thus, evaluating technology integration requires attention to both frequency of use and perceived effectiveness in particular mathematical domains.

In the Philippine basic education setting, the integration of technology-based learning materials remains shaped by uneven access to devices, internet connectivity, teacher training, and school-level support. Some schools may have access to interactive boards, computers, and online platforms, while others may rely on mobile phones, shared devices, or offline resources. These variations make district-level studies necessary because national policy directions do not always capture the specific conditions of teachers in local schools. Local evidence can reveal whether technology integration is widespread, which strategies are strongest, and where implementation support is most needed.

The present study is situated in Calauag East District, Division of Quezon, and centers on teachers’ strategies in integrating technology-based learning materials in Mathematics 6. It examined five strategy areas: multimedia-based learning, game-based learning, online collaborative platforms, interactive whiteboards, and educational apps. It also assessed perceived effectiveness across four mathematical content domains: understanding fractions and decimals, solving equations and expressions, measurement, and geometry skills. These variables reflect both the means of integration and the instructional outcomes that teachers associate with technology-based learning materials.

The study also investigated the degree of agreement among different school types in the ranking of integration, effectiveness, and implementation problems. Agreement testing is important because high average means alone do not show whether schools share similar implementation patterns. Kendall’s coefficient of concordance provides a way to examine whether respondents from different groups order the indicators consistently. This helps identify whether technology integration is uniform across school contexts or whether certain areas need differentiated support.

Teacher-reported problems were included because technology integration often appears successful at the level of adoption but difficult at the level of sustained classroom use. Technical disruptions, unstable internet connection, lack of devices, insufficient teacher training, classroom distraction, and limited digital content can weaken the instructional benefits of digital resources. The inclusion of these problems allows the study to balance positive effectiveness findings with realistic implementation constraints. This balance is essential for producing policy recommendations that are both ambitious and feasible.

The significance of this study lies in its contribution to evidence-informed educational leadership and curriculum supervision. For school heads, the findings can guide prioritization of resources, teacher training, and classroom monitoring. For curriculum coordinators, the results can inform the development of technology-integrated lesson templates and content-specific digital strategies. For teacher educators and professional development providers, the study identifies areas where teachers require stronger technological pedagogical preparation.

The study is also relevant to education technology units and policy planners because it identifies the infrastructure and support conditions that shape effective technology use. If digital transformation is to improve mathematics learning, schools must have systems for app selection, technical support, device deployment, connectivity enhancement, and data monitoring. Technology integration should be treated as a pedagogical and organizational process, not merely as equipment procurement. In this sense, the research offers a district-based model for linking classroom strategy, content effectiveness, teacher challenge, and policy response.

This article therefore reorganizes the study into an IMRAD journal format to present the findings in a coherent research publication structure. It begins with the rationale for technology-based mathematics instruction, proceeds to the descriptive-evaluative-correlational methodology, presents and discusses the empirical results, and concludes with implications for practice, policy, and future research. The central argument is that technology-based learning materials in Mathematics 6 were widely used and perceived as effective, but their full value depends on intentional pedagogy, content alignment, teacher training, and context-responsive support. This framing allows the findings to speak both to local decision-making and to broader discussions on digital technology in mathematics education.

2. Methodology

The study employed a descriptive-evaluative-correlational research design to determine the effectiveness of teachers' strategies in integrating technology-based learning materials in Mathematics 6. The descriptive component was used to determine the extent to which teachers integrated selected technology-based learning materials. The evaluative component was used to assess the perceived effectiveness of these materials across major Mathematics 6 content domains. The correlational component was represented by the use of Kendall's coefficient of concordance to test agreement in rank orders among the different school types.

The locale of the study was Calauag East District, Division of Quezon, for School Year 2024-2025. The district was selected purposively because it provided an appropriate setting for examining technology integration in elementary mathematics instruction. The locale included schools categorized by type, allowing the study to compare patterns across big, medium, and small schools. This categorization was important because school size can influence resource availability, teacher support, connectivity, and access to instructional technology.

The respondents consisted of sixty-seven teacher-respondents from the district, selected through total enumeration. Total enumeration was appropriate because the population of teachers included in the study was manageable and directly relevant to the research questions. This approach reduced sampling exclusion within the defined population and allowed the study to capture a fuller representation of teacher perceptions. The respondents provided ratings on technology integration, effectiveness of technology-based materials, and implementation problems.

The main research instrument was a structured questionnaire aligned with the study's statement of the problem. The instrument covered the extent of integration of technology-based learning materials in terms of multimedia-based learning, game-based learning, online collaborative platforms, interactive whiteboards, and use of educational apps. It also assessed perceived effectiveness along understanding fractions and decimals, solving equations and expressions, measurement, and geometry skills. A separate section identified problems encountered by teachers in using technology-based learning materials.

The instrument used weighted rating scales to obtain quantitative judgments from teacher-respondents. For integration indicators, the interpretations included very much employed, much employed, employed, fairly employed, and not at all. For effectiveness indicators, the interpretations included very much effective, much effective, effective, fairly effective, and not at all. For problems encountered, the scale described seriousness from very much serious to not at all, allowing the study to determine the intensity of implementation barriers.

Data gathering followed a survey procedure in which the questionnaire was administered to the identified teacher-respondents. The completed responses were organized according to school type and study variable. The use of grouped data allowed the researcher to compute means and rankings for big, medium, and small schools, as well as overall weighted means. The procedure produced data that could describe both general district patterns and differences in how school types ranked the same indicators.

The statistical treatment consisted of weighted mean, rank, Kendall's coefficient of concordance W, and the corresponding chi-square test. Weighted mean was used to determine the extent of integration, effectiveness, and seriousness of problems. Ranking was used to arrange indicators from highest to lowest according to mean ratings. Kendall's W was used to determine whether there was significant agreement among the rank orders of the different school types.

The chi-square value associated with Kendall's W was tested at the 0.05 level of significance. The degree of freedom used in the tests was based on the number of ranked indicators minus one. Where the computed chi-square exceeded the tabular value, the null hypothesis of no significant agreement was rejected. Where the computed chi-square did not exceed the tabular value, the null hypothesis was accepted, indicating that the rank orders did not show statistically significant agreement.

The methodological orientation of the study was appropriate for the research purpose because the study did not manipulate variables or implement an experimental intervention. Instead, it described actual teacher-reported practice, evaluated perceived effectiveness, and examined rank-order agreement across school types. The design therefore generated practical evidence that can inform supervision, professional development, resource allocation, and technology-integration policy. While the findings are grounded in teacher perceptions, they provide a useful basis for identifying strengths, implementation gaps, and policy directions for Mathematics 6 instruction.

3. Results and Discussions

This section presents the empirical results of the study in relation to the integration of technology-based learning materials, the perceived effectiveness of such materials in Mathematics 6, the agreement of rank orders among school types, the problems encountered by teachers, and the policy recommendations derived from the findings. The presentation follows the logic of the original research questions but condenses the data into journal-style tables. Each table is followed by analytical discussion that interprets the results in relation to pedagogy, curriculum implementation, school-level variation, and educational technology literature. The goal is to show not only what the weighted means and tests reveal, but also what these patterns imply for technology-supported mathematics instruction.

Table 1. Summary of the Extent of Integration of Technology-Based Learning Materials in Mathematics 6

Strategy Area	Big Schools	Medium Schools	Small Schools	Overall	Rank
Game-Based Learning	4.21 (ME)	4.53 (VME)	4.24 (ME)	4.33 (ME)	1
Use of Educational Apps	4.22 (ME)	4.39 (ME)	4.35 (ME)	4.32 (ME)	2
Multimedia-Based Learning	4.17 (ME)	4.53 (ME)	4.17 (ME)	4.29 (ME)	3
Interactive Whiteboards	4.12 (ME)	4.08 (ME)	4.22 (ME)	4.14 (ME)	4
Online Collaborative Platforms	4.10 (ME)	4.03 (ME)	4.02 (ME)	4.05 (ME)	5
Overall	4.16 (ME)	4.31 (VME)	4.20 (ME)	4.23 (ME)	

Note. VME = Very Much Employed; ME = Much Employed; numbers are weighted means. The overall mean was 4.23, interpreted as much employed.

Table 1 shows that technology-based learning materials were much employed in Mathematics 6 instruction, with an overall weighted mean of 4.23. This indicates that teachers in Calauag East District did not use digital resources merely occasionally; rather, they integrated them as recognizable components of their instructional strategies. Game-based learning ranked first with a mean of 4.33, suggesting that teachers frequently used digital games, gamified activities, rewards, challenges, and competitive or collaborative math tasks. The result is consistent with literature showing that game-based environments can increase learners' motivation, engagement, and willingness to practice mathematics (Hussein et al., 2022; Vankúš, 2021).

The high rank of educational apps, with a mean of 4.32, also indicates that app-based learning has become a practical tool in Mathematics 6 classrooms. Apps may be attractive to teachers because they can provide immediate feedback, practice problems, progress monitoring, adaptive tasks, and visual support. Their closeness in mean to game-based learning implies that teachers see apps as useful not only for enrichment but also for reinforcing core mathematics skills. However, this finding also requires attention to app quality, curriculum alignment, data privacy, and teacher capacity to interpret app-generated feedback.

Multimedia-based learning ranked third with a mean of 4.29, which remains a strong rating. This suggests that teachers commonly used videos, animations, audio-visual materials, charts, diagrams, simulations, and real-world multimedia examples to explain mathematical concepts. In elementary mathematics, multimedia is particularly useful because it can bridge concrete and abstract representations. The finding aligns with research indicating that digital tools are most effective when they are used to support visualization, guided exploration, and structured classroom activity (Cheung & Slavin, 2013; Hillmayr et al., 2020).

Interactive whiteboards and online collaborative platforms ranked fourth and fifth, respectively, but both were still interpreted as much employed. The lower relative ranking of online collaborative platforms may suggest that collaboration through digital tools requires stronger connectivity, clearer task design, and more advanced classroom routines. Meanwhile, the moderate position of interactive whiteboards may reflect uneven access to hardware or variation in teacher proficiency. Overall, the table points to a strong foundation in technology integration, while also showing that more infrastructure-dependent and collaboration-dependent strategies need additional support.

Table 2. Kendall's W Test of Agreement on Rank Orders for Integration Strategies

Indicator	Kendall W	Computed x2	df	Decision on Ho	Agreement
Multimedia-Based Learning	0.58	15.66	9	Accepted	Not Significant
Game-Based Learning	0.38	10.26	9	Accepted	Not Significant
Online Collaborative Platforms	0.98	26.46	9	Rejected	Significant
Interactive Whiteboards	0.34	9.18	9	Accepted	Not Significant
Use of Educational Apps	0.35	9.45	9	Accepted	Not Significant

Note. The tabular chi-square at 0.05 and df = 9 was 16.92. Online collaborative platforms exceeded the critical value and showed significant agreement.

Table 2 shows that the agreement of rank orders across school types was not uniform. Multimedia-based learning, game-based learning, interactive whiteboards, and educational apps did not show significant agreement because their computed chi-square values were lower than the tabular value of 16.92 at the 0.05 level. This means that although these strategies were much employed overall, big, medium, and small schools did not necessarily rank their specific indicators in the same way. The absence of significant agreement suggests contextual differences in how schools operationalized these technology-based strategies.

Online collaborative platforms were the exception, with W = 0.98 and computed chi-square = 26.46. This result indicates a high degree of consistency in the rank ordering of indicators for online collaboration among the school types. A possible interpretation is that online collaboration practices were perceived similarly across schools because the same practical conditions shaped their use, such as internet access, platform familiarity, and the complexity of managing group tasks online. Thus, while the overall mean for online collaborative platforms was the lowest among the integration areas, the ranking pattern was more consistent across school contexts.

The non-significant results for most integration strategies should not be read as weak implementation. Rather, they indicate variation in indicator-level priorities among school types. For example, one school type may emphasize real-world multimedia applications, another may emphasize app-based drills, and another may rely more on whiteboard demonstrations or game rewards. This variation is expected in technology integration because tools are mediated by local resources, class size, teacher training, available devices, and learners' readiness.

The findings support the need for district-level coordination without eliminating school-level flexibility. Standard templates and resource guides can help align technology integration with Mathematics 6 competencies, but schools should still be allowed to adapt strategies to their available tools and learners' needs. The significant agreement in online collaborative platforms also signals an area for focused improvement because shared perceptions can make district-wide training more coherent. In contrast, the varied rankings in other strategies require differentiated coaching, peer sharing, and school-specific implementation monitoring.

Table 3. Summary of the Extent of Effectiveness of Technology-Based Learning Materials in Mathematics 6

Content Domain	Big Schools	Medium Schools	Small Schools	Overall	Rank
Solving Equations and Expressions	4.36 (ME)	4.31 (ME)	4.35 (ME)	4.34 (ME)	1
Measurement	4.29 (ME)	4.10 (ME)	4.49 (ME)	4.29 (ME)	2
Understanding Fractions and Decimals	4.30 (ME)	4.12 (ME)	4.38 (ME)	4.27 (ME)	3
Geometry Skills	4.21 (ME)	3.84 (ME)	4.21 (ME)	4.09 (ME)	4
Overall	4.29 (ME)	4.09 (ME)	4.36 (ME)	4.25 (ME)	

Note. ME = Much Effective; numbers are weighted means. The overall mean was 4.25, interpreted as much effective.

Table 3 shows that technology-based learning materials were much effective across the four Mathematics 6 content domains, with an overall weighted mean of 4.25. This result is important because it indicates that the use of technology was not confined to engagement or presentation; teachers perceived it as contributing to actual instructional effectiveness. The highest-rated domain was solving equations and expressions, with a mean of 4.34. This suggests that technology is especially useful for modeling real-world scenarios, visualizing solution steps, providing interactive practice, and giving immediate feedback in algebra-related tasks.

Measurement ranked second with a mean of 4.29, indicating that technology-based materials were also effective in developing understanding of units, conversions, perimeter, area, volume, and practical measurement applications. Digital tools can simulate measurement activities, provide virtual rulers or grids, visualize conversions, and connect measurement to real-life tasks. Small schools reported the highest mean in measurement at 4.49, suggesting that technology may be especially valuable where physical resources or manipulatives are limited. In such cases, simulations and interactive visuals can compensate for gaps in concrete materials.

Understanding fractions and decimals ranked third with a mean of 4.27, which remains within the much effective range. This result is pedagogically meaningful because fractions and decimals are often difficult for learners due to their abstract and relational nature. Interactive diagrams, number lines, fraction circles, animations, and app-based drills can help learners connect part-whole relationships, equivalence, operations, and decimal place value. The result supports the broader claim that digital tools can strengthen conceptual understanding when they represent mathematical structures dynamically rather than merely supply answers.

Geometry skills ranked fourth with a mean of 4.09, still interpreted as much effective but comparatively lower than the other domains. Geometry requires spatial reasoning, manipulation of shapes, understanding of transformations, and interpretation of relationships such as congruence and similarity. The lower rank may indicate that effective geometry technology requires more specialized tools, such as dynamic geometry software, 3D models, augmented reality, or interactive construction platforms. The finding therefore points to the need for stronger technology alignment in geometry instruction, not to a rejection of technology in geometry.

Table 4. Kendall’s W Test of Agreement on Rank Orders for Effectiveness Domains

Content Domain	Kendall W	Computed x2	df	Decision on Ho	Agreement
Understanding Fractions and Decimals	0.35	9.45	9	Accepted	Not Significant
Solving Equations and Expressions	0.35	9.45	9	Accepted	Not Significant
Measurement	0.53	14.31	9	Accepted	Not Significant
Geometry Skills	0.76	20.52	9	Rejected	Significant

Note. The tabular chi-square at 0.05 and df = 9 was 16.92. Geometry skills exceeded the critical value and showed significant agreement.

Table 4 shows that the rank-order agreement for effectiveness domains was significant only for geometry skills. Understanding fractions and decimals, solving equations and expressions, and measurement had computed chi-square values below the 0.05 critical value. This indicates that the different school types did not rank the effectiveness indicators in these three areas in a statistically similar way. The finding may reflect the variety of digital resources used for these topics, including videos, apps, quizzes, simulations, and teacher-made materials.

Geometry skills showed significant agreement with W = 0.76 and computed chi-square = 20.52. This means that respondents from different school types were more consistent in how they ranked technology effectiveness indicators in geometry. One possible reason is that geometry-related technology use is strongly associated with visible and recognizable functions, such as manipulating shapes, visualizing angles, demonstrating transformations, and constructing figures. These functions may be easier for teachers to rank consistently because they directly correspond to the visual-spatial nature of geometry.

The significant agreement for geometry must be interpreted together with its lower mean score in Table 3. Although geometry was rated much effective, it was the lowest-ranked content domain. This combination suggests that teachers agreed on the relative value of geometry-related technology indicators, but the overall strength of effectiveness could still be improved. Thus, geometry appears to be an area where teachers share similar perceptions but may need better tools, training, or content-specific digital resources.

The results imply that technology integration should be planned by mathematical content area rather than treated as a single generic intervention. Fractions, equations, measurement, and geometry have different representational demands and therefore require different digital tools. For geometry, schools may benefit from dynamic geometry software, interactive whiteboard activities, and guided spatial tasks. For fractions, equations, and measurement, schools may focus on simulations, adaptive practice, tutorials, and feedback mechanisms that correspond to specific conceptual and procedural learning goals.

Table 5. Problems Encountered by Teachers in the Utilization of Technology-Based Learning Materials

Problem Indicator	Overall Wx	Interpretation	Rank
Technical issues with educational apps or software during lessons, leading to interruptions in instruction	3.50	Much Serious	1.5
Insufficient teacher training in effectively integrating technology-based materials into the curriculum	3.50	Much Serious	1.5
Challenges in maintaining classroom control or focus when learners become distracted by non-educational apps or websites	3.48	Serious	3
Limited access to reliable internet connectivity, affecting seamless use of online resources	3.30	Serious	4
Inadequate availability of digital devices such as computers or tablets for learners	3.11	Serious	5
Difficulty in finding age-appropriate and curriculum-aligned technology-based learning materials	3.06	Serious	6
Over-reliance on technology leading to a decrease in hands-on activities and traditional learning methods	2.92	Serious	7
Limited access to updated or current digital content for certain topics or subjects	2.67	Serious	8
Difficulty managing learners' engagement during independent technology-based activities	2.53	Serious	9
Insufficient school or district support for funding, acquiring, and maintaining technology-based tools	2.52	Serious	10
Overall	3.06	Serious	

Note. The overall mean was 3.06, interpreted as serious. The highest-rated problems involved technical disruptions and insufficient teacher training.

Table 5 shows that the problems encountered by teachers were serious, with an overall weighted mean of 3.06. The highest-rated concerns were technical issues during lessons and insufficient teacher training, both with means of 3.50 and interpreted as much serious. These findings are critical because they reveal that the main barriers are not limited to learner behavior or resource availability; they also involve system readiness and teacher capacity. Even effective tools can lose instructional value when software fails, devices malfunction, or teachers do not have enough preparation to integrate them into the curriculum.

Classroom distraction ranked third with a mean of 3.48, suggesting that teachers faced challenges in maintaining learner focus during technology-mediated activities. This is a common implementation concern because devices can support learning but can also open access to non-educational content. The result implies that technology integration requires classroom protocols, monitoring routines, app restrictions, and carefully structured tasks. Without these safeguards, digital tools may increase engagement superficially while weakening mathematical attention.

Connectivity and device availability also emerged as serious problems. Limited internet access obtained a mean of 3.30, while inadequate digital devices obtained a mean of 3.11. These findings show that technology integration depends on physical and digital infrastructure as much as on teacher interest. In schools where connectivity is unstable or devices are insufficient, teachers may hesitate to plan technology-dependent lessons because implementation failure can interrupt instruction.

The lower-ranked problems, such as limited updated content, difficulty managing engagement, and insufficient funding support, were still interpreted as serious. This indicates that none of the listed barriers can be ignored. The data support a layered approach to intervention: immediate technical support, sustained teacher training, improved connectivity, device provision, resource vetting, and classroom management guidelines. Such support is aligned with UNESCO's (2023) reminder that education technology should be evaluated not only by innovation but also by appropriateness, equity, and sustainability.

Table 6. Kendall's W Test of Agreement on Rank Orders for Problems Encountered

Indicator	Kendall W	Computed x2	df	Decision on Ho	Agreement
Problems Encountered	0.32	8.64	9	Accepted	Not Significant

Note. The tabular chi-square at 0.05 and df = 9 was 16.92. The computed value did not exceed the critical value, indicating no significant agreement.

Table 6 indicates that there was no significant agreement on the rank orders of the problems encountered by teachers across the different school types. The coefficient of concordance was W = 0.32, and the computed chi-square value of 8.64 was below the tabular value of 16.92 at the 0.05 level. This means that big, medium, and small schools did not rank implementation problems in the same way. The problems were therefore serious overall, but their priority order differed by context.

The absence of significant agreement is understandable because technology-related barriers are often context-specific. A school with devices but unstable internet may rank connectivity as the main concern, while another school with connectivity but limited teacher training may rank professional development higher. Similarly, classroom distraction may be more pressing in schools where learners have more individual device access. These variations show why policy interventions should begin with needs assessment rather than assuming uniform conditions across schools.

This finding also implies that district support should combine common system-wide measures with differentiated school-level interventions. Common measures may include app vetting, helpdesk support, quarterly training, and technology-integrated lesson planning. Differentiated measures may include connectivity support for schools with weak internet, device deployment for under-resourced classrooms, and coaching for teachers who need help with classroom management in digital settings. This combination can prevent both overgeneralization and fragmented implementation.

The result contributes an important caution to the overall positive findings on technology use and effectiveness. High integration and effectiveness ratings do not mean that schools experience the same barriers or require the same solutions. Effective technology governance must therefore be diagnostic, responsive, and evidence-based. For Calauag East District, this means that policy recommendations should be translated into school-specific implementation plans supported by monitoring, feedback, and resource mapping.

Table 7. Consolidated Policy Recommendations Derived from the Findings

Policy Area	Recommended Action
Curriculum alignment	Develop standard lesson templates integrating game-based learning, multimedia resources, educational apps, and content-specific technology tasks.
Teacher training	Conduct quarterly workshops, biweekly tech clinics, peer-observation cycles, and micro-credentials on technology-based mathematics pedagogy.
Infrastructure and access	Upgrade internet infrastructure, deploy preloaded tablets or mobile devices, and install or maintain interactive whiteboards where feasible.
Quality assurance of digital tools	Vet and approve educational apps and platforms aligned with Mathematics 6 competencies, age appropriateness, and assessment requirements.
Technical support	Provide dedicated helpdesk support and troubleshooting mechanisms for teachers encountering software, app, connectivity, or device problems.
Monitoring and research	Conduct annual audits, track usage metrics, measure student gains, and pilot comparative studies on traditional and technology-enhanced mathematics instruction.
Community and stakeholder support	Mobilize PTAs, LGUs, professional learning communities, and EdTech partnerships to sustain technology integration initiatives.

Note. The recommendations synthesize the detailed policy directions identified in the study into implementable action areas for district and school-level planning.

Table 7 synthesizes the policy recommendations into seven action areas that correspond to the empirical findings. Curriculum alignment is necessary because the highest-rated technology strategies must be translated into planned lessons rather than left to individual teacher improvisation. Standard templates can help teachers decide when to use games, apps, multimedia, collaborative platforms, or whiteboards in relation to specific Mathematics 6 competencies. Such templates can also reduce preparation burden and strengthen consistency across schools.

Teacher training is the most urgent professional development implication because insufficient training was one of the most serious problems identified in the study. Training should not be limited to tool demonstration; it should address pedagogical decision-making, content alignment, classroom management, assessment, and troubleshooting. Professional learning communities and peer observation can help teachers learn from colleagues who already use technology effectively. Micro-credentials can further motivate teachers to develop demonstrable competencies in interactive whiteboard pedagogy, app-based assessment, multimedia lesson design, and game-based learning facilitation.

Infrastructure and technical support are equally essential because teacher competence alone cannot overcome unstable connectivity, inadequate devices, or frequent software disruptions. Schools need reliable internet, accessible devices, maintained hardware, and rapid helpdesk support. App vetting is also important because teachers need assurance that digital tools are curriculum-aligned, safe, age-appropriate, and instructionally sound. These support systems can help move technology integration from individual effort to organizational practice.

Monitoring and stakeholder engagement complete the policy framework because technology integration must be sustained, evaluated, and locally supported. Usage metrics, annual audits, student performance measures, and teacher feedback can help school leaders determine which tools are producing instructional value. LGUs, PTAs, and EdTech partners can support resource mobilization, especially for under-resourced schools. In this way, the policy recommendations convert the study’s findings into a practical improvement agenda for Mathematics 6 instruction in the district.

4. Conclusions and Implications

4.1 Conclusions

The study concludes that technology-based learning materials were much employed in Mathematics 6 instruction in Calauag East District. The overall mean of 4.23 demonstrates that teachers integrated digital resources in a consistent and meaningful manner. Game-based learning, educational apps, and multimedia-based learning emerged as the strongest integration strategies. This suggests that teachers preferred tools that support motivation, visual explanation, practice, feedback, and interactive engagement.

The level of integration varied across strategy areas, which shows that technology use was not homogeneous. Online collaborative platforms obtained the lowest mean among the integration dimensions, although they were still much employed. This indicates that collaboration-oriented technologies may require more stable infrastructure, stronger facilitation skills, and clearer online task structures. Interactive whiteboards also showed room for improvement, especially if schools intend to maximize learner manipulation, whole-class problem solving, and visual demonstration.

The rank-order agreement results for integration show that most strategies did not have significant agreement across school types. This means that big, medium, and small schools ranked many technology-integration indicators differently. Online collaborative platforms were the only integration area with significant agreement, suggesting stronger consistency in how respondents viewed or ranked this dimension. Overall, the results indicate that technology integration in the district is active but shaped by contextual differences across schools.

The study further concludes that technology-based learning materials were much effective in teaching Mathematics 6. The overall effectiveness mean of 4.25 indicates that teachers perceived digital resources as contributing positively to mathematics learning. Solving equations and expressions received the highest rating, followed by measurement, understanding fractions and decimals, and geometry skills. These results suggest that technology was valuable across both procedural and conceptual domains of Mathematics 6. Despite the positive effectiveness ratings, the lower relative mean for geometry skills indicates an area requiring further instructional strengthening. Geometry depends heavily on spatial reasoning, dynamic representation, and manipulation of figures. Teachers may need more specialized digital tools and training to fully develop learners' geometric understanding. Therefore, the effectiveness of technology in geometry should be enhanced through dynamic geometry software, interactive whiteboard use, 3D modeling, guided construction tasks, and real-world spatial applications.

The agreement test for effectiveness indicates that only geometry skills showed significant agreement in rank orders across school types. This suggests that teachers were more consistent in identifying which geometry-related technology indicators were effective. However, the fact that geometry had the lowest domain mean means that shared perceptions did not necessarily translate to the strongest effectiveness rating. This conclusion supports a targeted improvement agenda for geometry-focused technology integration.

The study also concludes that teachers encountered serious problems in using technology-based learning materials. The most serious problems were technical issues during lessons and insufficient teacher training in integrating technology into the curriculum. Other concerns included classroom distraction, limited internet connectivity, inadequate devices, and difficulty finding age-appropriate and curriculum-aligned materials. These findings confirm that effective technology integration requires instructional, technical, infrastructural, and administrative support.

Finally, the absence of significant agreement on the rank orders of problems shows that schools experienced implementation barriers differently. This means that one school's most urgent concern may not be the same as another school's priority. Policy recommendations should therefore be district-guided but school-responsive. The study concludes that sustainable technology integration in Mathematics 6 requires coordinated curriculum planning, continuous professional development, infrastructure investment, technical support, digital-resource quality assurance, and regular monitoring.

4.2 Implications

The findings imply that Mathematics 6 instruction can benefit substantially from technology-based learning materials when teachers use them with clear pedagogical intent. School leaders should not treat digital resources as optional enrichment but as instructional assets that can support visualization, practice, feedback, and student engagement. However, technology should be aligned with learning competencies and lesson objectives. The implication is that technology integration must be planned, supervised, and evaluated as part of curriculum implementation.

For teachers, the study implies the need to move beyond operational familiarity with digital tools toward technological pedagogical content knowledge. Teachers must know which tools are appropriate for fractions, equations, measurement, or geometry, and how each tool changes the way learners encounter mathematical ideas. Training should therefore focus on lesson design, questioning techniques, scaffolding, assessment interpretation, and classroom management during digital activities. This type of professional development is more likely to improve learning than short tool-orientation sessions.

For curriculum coordinators, the high ratings for game-based learning, educational apps, and multimedia-based learning suggest that these strategies should be incorporated into formal lesson templates and instructional guides. Curriculum documents can specify recommended digital tools, task examples, assessment prompts, and alternative low-tech options. This can help teachers integrate technology consistently without compromising flexibility. It can also ensure that digital activities remain focused on mathematical understanding rather than entertainment alone.

For school heads and district supervisors, the findings imply the need to monitor both access and pedagogy. It is not enough to know whether teachers use technology; supervisors should also examine whether technology use strengthens learner participation, concept development, problem solving, and feedback. Observation tools may include indicators on alignment, interactivity, learner engagement, assessment, and troubleshooting. This approach can transform supervision from compliance checking into instructional coaching.

For ICT units and educational technology personnel, the serious problems identified in the study imply a need for proactive technical support. Helpdesk systems, device maintenance plans, app troubleshooting guides, and connectivity monitoring should be institutionalized. Teachers should have accessible support before, during, and after technology-supported lessons. Reducing technical interruptions can protect instructional time and increase teacher confidence in using digital tools.

For resource allocation, the findings imply that investments should be targeted according to school-specific needs. Some schools may require internet upgrades, while others may need devices, interactive whiteboards, app licenses, or teacher training. Because the problems did not show significant agreement across school types, uniform allocation may not solve the most urgent barriers. Data-based resource mapping should guide district and LGU support.

For policy development, the study implies that technology integration should be supported by a coherent district framework. This framework may include approved apps, standard lesson templates, professional learning communities, quarterly workshops, annual audits, student performance tracking, and stakeholder support mechanisms. Such a framework can help maintain quality while allowing schools to adapt to local conditions. It can also ensure that technology integration remains sustainable beyond individual teacher initiative.

For future research, the findings imply the need to connect teacher perceptions with student learning evidence. Subsequent studies may examine actual student achievement, engagement, retention, mathematical communication, and problem-solving performance after exposure to specific technology strategies. Research may also compare urban and rural implementation contexts, evaluate cost-effectiveness, and investigate how teacher digital literacy influences instructional outcomes. These future directions can strengthen the evidence base for technology-enhanced Mathematics 6 instruction.

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