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Development of Google Classroom as a Learning Management System for Mathematics 4 Instruction

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Index Terms:

google classroom, learning management system, mathematics 4 instruction, instructional design, MATATAG curriculum

Abstract. Instructional gaps in mathematics and frequent classroom interruptions disrupt learning continuity and hinder conceptual understanding among elementary learners. In Grade 4 Mathematics at Ratay Elementary School during the first quarter of SY 2024–2025, the MATATAG Curriculum implementation relied on official lesson exemplars that, upon analysis, revealed minimal conceptual explanations, limited real-life applications, procedural imbalance, and no technology integration. This study aimed to analyze Grade 4 Mathematics lesson exemplars for content, structure, and assessment, and to design and develop a learning management system (LMS) using Google Classroom aligned with MATATAG competencies. A descriptive–developmental research design guided by the Analysis–Design–Development (ADD) model was employed. Qualitative content analysis was conducted on eight official Grade 4 Quarter 1 lesson exemplars to identify instructional gaps that informed system design. The development phase resulted in a prototype of Google Classroom LMS (Version 1) featuring structured lesson slides, discussion tools, adaptive learning tasks, and progress-monitoring features. Expert evaluation was conducted involving five Master Teachers who assessed the system using a three-point appropriateness scale. Results showed that key features—including the Lesson Slide Archive, MathTalk Live/Replay, Assignment Section, Adaptive Learning Tasks, and Progress Point—received high sustainability ratings (2.6–2.8). Other features—Videos, MathTalk Assistance, TaskFolio, and FlashQuiz—received moderate ratings (2.0–2.2), indicating areas for improvement. Based on these findings, Version 2 of the LMS integrated interactive self-check activities, a formula vault, MathLab applications, enhanced visual supports, and improved progress tracking. The study highlights the potential of technology-integrated instructional platforms to address curricular gaps and support sustained mathematics learning under the MATATAG framework.

Introduction

The rapid expansion of digital learning has transformed how schools conceptualize instructional continuity, particularly in contexts where face-to-face teaching is frequently interrupted. In basic education, learning management systems (LMSs) have become increasingly important not only as administrative platforms for communication and task submission, but also as potential instructional environments that can extend learning beyond classroom walls (Bradley, 2021; Zakaria, 2023). This shift is especially significant in elementary Mathematics, where mastery depends on sustained practice, guided explanation, and timely reinforcement of foundational skills. Research on effective elementary mathematics instruction emphasizes the importance of structured support, active learning, feedback, and meaningful engagement in developing conceptual understanding and procedural fluency (Bognar et al., 2025; Koskinen & Pitkäniemi, 2022). In such settings, interruptions to regular instruction may weaken conceptual development and create cumulative learning gaps that affect subsequent performance.

In the Philippine public school context, these concerns are particularly acute. Rural and semi-urban schools often contend with disruptions caused by weather disturbances, school-based activities, scheduling constraints, and shortened class periods. At the elementary level, where Mathematics competencies are sequential and cumulative, missed lessons may result in incomplete mastery of prerequisite concepts in numeracy, problem-solving, and conceptual reasoning. These instructional realities are further complicated by the implementation of the MATATAG curriculum, which emphasizes a more focused progression of competencies and a stronger concentration on foundational learning and mastery across grade levels (DepEd, 2024). While the curriculum promotes instructional efficiency and conceptual depth, its implementation in disrupted learning environments places greater pressure on teachers to maintain continuity, provide reinforcement, and ensure competency attainment despite limited instructional time.

These challenges are evident in Grade 4 Mathematics at Ratay Elementary School in the Calabanga East District, Division of Camarines Sur. Teachers reported that recurring interruptions to classroom instruction constrained lesson pacing, reduced opportunities for practice and reinforcement, and sometimes required progression to new content before learners had mastered prerequisite skills. Although first-quarter Mathematics lesson exemplars served as the primary instructional guides, these materials were designed largely for uninterrupted face-to-face delivery. As a result, they did not always provide sufficient flexibility for revisiting missed lessons, extending learning opportunities, or differentiating instruction when classroom time was reduced. This limitation created a need for a more structured support mechanism capable of preserving learning continuity while remaining aligned with curriculum standards and local instructional conditions.

Within this context, Google Classroom and other LMSs emerged as potentially valuable platforms for organizing lessons, distributing materials, and sustaining communication between teachers and learners. A systematic review by Zakaria (2023) found that users generally reported favorable perceptions of Google Classroom and associated it with positive learning outcomes in mathematics education. However, Zakaria (2023) also noted that much of the existing literature has focused on usability, perception, and implementation rather than on the systematic development of Google Classroom as an instructional environment. In elementary education, this distinction is especially important because successful LMS use depends not only on platform access but also on teacher readiness, school support, and instructional alignment. In a UTAUT-based study involving 426 elementary school teachers, Marmoah et al. (2024) found that performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, and habit were significantly associated with LMS adoption. Similarly, Suwondo et al. (2022) showed that teacher performance, school leadership, and infrastructure conditions influence the effectiveness of Google Classroom implementation in elementary mathematics. Together, these findings suggest that the instructional value of Google Classroom is not automatic; rather, it depends on purposeful design, teacher capability, and enabling school conditions (Marmoah et al., 2024; Suwondo et al., 2022; Zakaria, 2023.

Related studies on mathematics-specific digital learning environments further clarify what effective digital support may look like in the elementary grades. Bang et al. (2023) found that the adaptive game-based platform My Math Academy significantly improved learning outcomes among kindergarten and Grade 1 pupils, while also increasing learner engagement, motivation, and confidence in mathematics. At the primary level, Pereda Loriente et al. (2025) reported that personalized instructional sequences delivered through the Moodle LMS significantly improved pupils' performance in fractions and decimal numbers, especially in learning fractions. At the review level, Son (2024) observed that intelligent tutoring systems in mathematics education are most commonly applied at the elementary level and tend to focus on foundational domains such as number and arithmetic, algebra, and geometry, highlighting the value of adaptive support, guided progression, and timely feedback. Taken together, these studies indicate that digital mathematics environments become more instructionally meaningful when they move beyond file storage or assignment posting and instead provide guided practice, personalized pathways, scaffolds, and feedback that support learner progression (Bang et al., 2023; Pereda Loriente et al., 2025; Son, 2024.

In the Philippine setting, this discussion aligns with broader national efforts to strengthen digital learning in basic education. DepEd's Digital Rise Program frames educational technology around three major components—digital literacy, ICT-assisted teaching, and ICT-assisted learning—and links these efforts to national platforms such as the DepEd Learning Management System, DepEd Commons, and the Learning Resources Portal, as well as partnerships with technology providers such as Microsoft and Google (DepEd, 2022). These initiatives indicate a policy-level recognition that digital platforms can support continuity, access, and flexibility in teaching and learning. Nevertheless, despite these reforms and the growing scholarship on Google Classroom and LMS use, relatively few studies have examined the development of Google Classroom as an elementary-level Mathematics LMS anchored in curriculum materials or lesson exemplars, particularly in public school settings where continuity, mastery, and focused competency development remain pressing concerns (Marmoah et al., 2024; Pereda Loriente et al., 2025; Zakaria, 2023). This gap is particularly important in Grade 4 Mathematics, where disruptions in instruction can directly undermine learners' acquisition of essential and foundational competencies.

Addressing this gap, the present study focused on the development of Google Classroom as a Learning Management System for Grade 4 Mathematics at Ratay Elementary School. Rather than assessing user perceptions alone, the study adopted a descriptive-developmental orientation to analyze first-quarter lesson exemplars, identify instructional gaps in content, structure, and assessment, and use those findings as the basis for designing and developing a curriculum-aligned Google Classroom environment. In this way, the study positioned Google Classroom not merely as an administrative platform, but as a structured instructional support system intended to sustain learning continuity, reinforce essential competencies, and provide learners with organized opportunities for review, guided practice, and feedback beyond classroom time.

The study is limited to the Analysis, Design, and Development phases of the ADDIE model and is confined to Grade 4 Mathematics first-quarter competencies under the MATATAG curriculum. It does not include classroom implementation with learners, comparative testing with other LMS platforms, or direct measurement of student achievement outcomes. Nevertheless, the study contributes to the literature by shifting attention from perception-based evaluation toward curriculum-aligned LMS development in elementary education. It also offers a practical model for teachers and schools seeking to optimize existing digital platforms in contexts where instructional time is frequently disrupted and continuity of learning is a persistent concern.

The succeeding sections present the Objectives of the Study, Assumptions of the Study, and Conceptual Framework, followed by the methodology, results and discussion, and conclusions and implications.

Objectives of the Study

The core problem addressed in this study is the absence of a systematically developed, curriculum-aligned digital instructional support system for Grade 4 Mathematics, particularly in contexts where classroom disruptions frequently hinder the continuity of instruction and the attainment of competency mastery. This gap is significant because it directly affects learners' acquisition of foundational Mathematics skills and limits teachers' capacity to deliver consistent and adaptive instruction under constrained conditions. In response to this need, there is a clear demand for a structured and responsive digital learning environment that can support both teaching and learning processes.
Anchored on this problem, the main objective of the study is to develop a Google Classroom-based Learning Management System (LMS) aligned with the first-quarter Grade 4 Mathematics competencies under the MATATAG curriculum.

Specifically, the study sought to:

1. analyze the Grade 4 Mathematics lesson exemplars in terms of content, structure, and assessment;
2. design a Google Classroom environment that aligns with identified competencies and addresses gaps observed in the lesson exemplars;
3. develop and refine the Google Classroom LMS based on expert inputs.

Assumptions of the Study

This study is based on several assumptions. First, it assumes that a systematic analysis of first-quarter Grade 4 Mathematics lesson exemplars can reveal gaps in content, structure, and assessment that are relevant to instructional continuity and competency mastery. Second, it assumes that classroom interruptions—including weather-related suspensions, scheduling limitations, and other unforeseen events—can hinder sustained Mathematics learning and therefore justify the need for a digital support system. Third, it assumes that expert feedback from master teachers and other qualified reviewers can provide credible guidance for refining the developed Google Classroom LMS. These assumptions are not treated as hypotheses but as necessary premises that frame the scope of the study.

Conceptual Framework

This study is anchored on the view that an effective digital learning environment in elementary Mathematics emerges from the deliberate alignment of curriculum content, instructional design, learner support, and technological functionality. In this study, the framework begins with two major instructional inputs: the first-quarter Grade 4 Mathematics lesson exemplars and the MATATAG curriculum competencies. These inputs define the essential content, intended learning outcomes, sequencing of lessons, and assessment expectations that must be reflected in the learning management system. They also serve as the basis for identifying instructional gaps that may hinder continuity of learning, particularly in contexts where classroom teaching is frequently disrupted.

At the center of the framework is the assumption that lesson exemplars should not be transferred to Google Classroom in a purely mechanical manner. Rather, they need to be systematically analyzed and transformed into structured digital learning components that respond to actual instructional needs. In this study, these needs include competency reinforcement, logical sequencing of concepts, alignment of activities and assessments, availability of guided practice, and opportunities for timely feedback. These elements are treated as the key design dimensions of the LMS because they directly influence whether the platform can support continuity of instruction and strengthen learners' mastery of foundational Mathematics competencies. Thus, the framework positions instructional design as the critical mechanism that connects curriculum requirements to the actual organization of the digital learning environment.

The framework is theoretically grounded in four complementary perspectives that explain how Google Classroom can function as a meaningful instructional support system. Social Constructivism provides the foundation for designing learning tasks that promote guided interaction, collaborative meaning-making, and active engagement in problem solving. This perspective supports the inclusion of discussion opportunities, interactive tasks, and teacher-guided activities that allow learners to build conceptual understanding through participation rather than passive reception. The Community of Inquiry Framework strengthens this view by emphasizing the interrelationship among teaching presence, social presence, and cognitive presence in online learning. In the context of this study, teaching presence informs the structured organization of lessons and teacher guidance within Google Classroom; social presence supports interaction and participation; and cognitive presence guides the inclusion of activities that encourage learners to apply, reflect on, and deepen their understanding of Grade 4 Mathematics concepts.

The framework is further supported by Self-Determination Theory, which explains that learner engagement is enhanced when the learning environment promotes autonomy, competence, and relatedness. Applied to this study, autonomy is supported by giving learners flexible access to instructional materials and activities beyond classroom hours; competence is strengthened through clearly sequenced lessons, guided practice, and aligned assessment tasks; and relatedness is encouraged through communication and interaction with teachers and peers using the platform. In addition, the Technological Pedagogical Content Knowledge (TPACK) framework provides the basis for integrating digital tools with pedagogical strategies and subject content. Through this lens, Google Classroom is not treated as an isolated technology but as a platform whose features must be deliberately matched with Grade 4 Mathematics content and appropriate instructional methods. Together, these theories establish that the effectiveness of the LMS depends on the meaningful integration of content, pedagogy, interaction, motivation, and technology.

Operationally, the framework is realized through the Analysis, Design, and Development phases of the ADDIE model, which function as the study's process structure. In the analysis phase, the first-quarter lesson exemplars are reviewed to identify issues in content, structure, and assessment, as well as areas requiring reinforcement, extension, and improved alignment with competencies. In the design phase, the findings from the analysis are translated into a structured plan for organizing topics, presenting lessons, sequencing activities, embedding assessments, and incorporating feedback mechanisms within Google Classroom. In the development phase, these plans are converted into actual digital instructional components, resulting in a functional LMS that reflects curriculum expectations and responds to the identified instructional needs. This sequence shows that the developed platform is not created independently of the curriculum; rather, it is systematically derived from existing lesson materials and refined through an instructional design process.

Viewed through an input–process–output (IPO) perspective, the framework identifies the lesson exemplars and MATATAG curriculum competencies as the inputs, the Analysis–Design–Development phases of ADDIE as the process, and the Google Classroom–based Learning Management System as the output. The relationship among these elements is linear and functional: curriculum-based inputs are first examined, then transformed through instructional design procedures, and finally organized into a digital platform intended to support teaching and learning. The expected output is not simply a repository of files, but a structured LMS containing organized lesson materials, competency-aligned activities, embedded assessments, and feedback opportunities that collectively support instructional continuity and competency mastery in Grade 4 Mathematics.

This framework directly informs the methodology of the study by justifying the use of a descriptive-developmental approach and by clarifying the sequence through which the LMS is analyzed, designed, and developed. It also establishes the basis for evaluating the platform in terms of its organization, alignment, and instructional usefulness. As an expected outcome, the framework suggests that a Google Classroom environment grounded in lesson exemplars, curriculum competencies, and sound instructional theory can provide a context-responsive digital support system for elementary Mathematics instruction. In this way, the conceptual framework explains not only what the study develops, but also why the development process is expected to contribute to learning continuity, structured instruction, and reinforcement of foundational competencies under the MATATAG curriculum.

Methodology

Research Design

This study utilized a descriptive-developmental research design anchored on the Analysis–Design–Development (ADD) model in developing a Google Classroom–based learning management system (LMS) for Grade 4 Mathematics under the MATATAG Curriculum. The design was appropriate because the study sought both to examine existing instructional materials and to develop an intervention responsive to the instructional needs identified through such examination. Specifically, the descriptive component was employed to analyze the Grade 4 Mathematics Quarter 1 lesson exemplars and determine their strengths, weaknesses, and instructional gaps in relation to content delivery, lesson organization, learner interaction, and assessment provisions. This phase provided the empirical basis for identifying areas requiring instructional enhancement.

The developmental component guided the design and refinement of the Google Classroom–based LMS as a curriculum-aligned digital instructional support system. Through the ADD model, the study was able to proceed systematically from the analysis of instructional needs to the design and development of platform features intended to address the identified gaps. The use of a descriptive-developmental design is a strength of the study because it supports the creation of a practical and context-sensitive educational intervention grounded in actual classroom needs. However, the findings of the study are limited to the specific context in which the LMS was developed and do not aim to determine causal effects. Rather, the design provides a structured basis for generating a relevant instructional model that may serve as a reference for similar development efforts in comparable settings.

Research Locale

The study took place at Ratay Elementary School, a public institution situated in Barangay Santa Cruz (Ratay), Calabanga, Camarines Sur, Philippines, under the jurisdiction of the Schools Division Office of Camarines Sur, during the first quarter of School Year 2024–2025. This school was intentionally chosen because its location in a coastal municipality exposes it to frequent typhoons and heavy monsoon rains, often disrupting face-to-face instruction. Alongside these geographic challenges, persistent issues such as student absenteeism, numerous school-based activities, and unreliable internet connectivity underscored the need for an innovative solution. These circumstances provided a compelling context for developing a low-bandwidth Google Classroom learning management system, aimed at supporting the uninterrupted delivery of Grade 4 Mathematics instruction in a rural public school setting.

Units of Analysis and Participants

The primary unit of analysis in this study comprised the eight officially issued Grade 4 Mathematics Quarter 1 lesson exemplars under the MATATAG Curriculum. These exemplars were analyzed as documentary sources with respect to their content, instructional structure, and assessment.

For the developmental phase, five Master Teachers from Ratay Elementary School participated as expert evaluators of the research instruments and of the initial Google Classroom prototype. They were purposively selected for their specialization in Mathematics, supervisory experience, and a Highly Proficient rating under the Philippine Professional Standards for Teachers (PPST). Their teaching experience ranged from 8 to 15 years, and their Mathematics supervisory experience ranged from 5 to 11 years.

Instruments

Two researcher-developed instruments were used. The first was a post-hoc evaluation checklist used to assess the lesson exemplars after initial qualitative immersion in the documents. The checklist contained six indicators distributed across three domains: content, instructional structure, and assessment. The second was an expert evaluation form for the Google Classroom prototype. This form included a three-point rating scale—1 = Inappropriate, 2 = Appropriate, 3 = Very Appropriate—and open-ended prompts for qualitative comments and recommendations.

The content of both instruments was derived from the MATATAG Curriculum Guide, DepEd Order No. 001, s. 2023, DepEd Order No. 42, s. 2016, and the themes that emerged during the analysis of the exemplars. Prior to use, both tools underwent expert review by experienced Master Teachers to assess clarity, relevance, and curriculum alignment. Minor revisions were made to item wording and indicator definitions. Although no formal statistical validation or pilot-testing procedure was reported, trustworthiness was strengthened through expert review, use of consistent rating anchors, and triangulation of numeric ratings with narrative feedback.

Data Gathering Procedure

Data gathering followed the three phases of the ADD model.

In Analysis Phase, the researcher conducted a qualitative content analysis of the eight Grade 4 Mathematics Quarter 1 lesson exemplars. Using open-ended, note-based thematic observation, the researcher examined the documents for recurring patterns and gaps related to curriculum alignment, conceptual progression, scaffolding, worked examples, and formative assessment. Based on these emergent findings, a post-hoc checklist was developed and applied to organize the identified strengths, weaknesses, and instructional gaps.

In Design Phase, the results of the exemplar analysis were translated into the proposed features of a Google Classroom–based LMS. The design focused on addressing the gaps identified in the exemplars, particularly limited conceptual depth, insufficient worked examples, and weak formative assessment opportunities. The platform was structured to include guided practice tasks, real-life application activities, formative assessments, feedback mechanisms, and differentiated tasks aligned with Grade 4 Mathematics competencies under the MATATAG Curriculum.

In Development Phase, the initial prototype of the Google Classroom was presented to the five Master Teachers for expert evaluation. The evaluators assessed the appropriateness of each feature in terms of curriculum alignment and its capacity to address the instructional gaps and learning disruptions identified in Phase 1. Quantitative ratings and qualitative comments were then consolidated and used to revise the prototype, resulting in Google Classroom Version 2.

Data Analysis

To address the first objective, the lesson exemplars were subjected to qualitative content analysis in order to identify recurring themes, strengths, weaknesses, and instructional gaps. The analysis was guided by the study's three analytic domains: content, instructional structure, and assessment. The findings from this phase provided the basis for determining the instructional needs that informed the development of the intervention.

For the second objective, the results of the exemplar analysis were used to guide the design of the Google Classroom–based learning management system. The instructional gaps identified in the exemplars were translated into platform features intended to improve content accessibility, lesson organization, learner engagement, and assessment opportunities. The design of the platform was anchored on the first-quarter Grade 4 Mathematics competencies under the MATATAG Curriculum.

To address the third objective, expert evaluation data were analyzed through a convergent descriptive approach, integrating both quantitative and qualitative data. Quantitative responses were summarized using the mean rating for each platform feature, computed using the formula: $\underline{x} = \frac{\sum x}{n}$, where $\sum x$ is the total score assigned by the evaluators and n is the number of evaluators. The following verbal interpretations were used for the mean ratings: 1.00–1.49 = Inappropriate, 1.50–2.49 = Appropriate, and 2.50–3.00 = Very Appropriate.

The qualitative data consisted of the evaluators' comments and suggestions for improving the LMS prototype. These responses were reviewed and analyzed to identify recurring concerns, observed strengths, and recommended revisions. The comments were grouped into thematic categories such as strengths, weaknesses, and recommendations for improvement. The integration of the quantitative ratings and qualitative feedback informed the refinement of the platform and provided a more comprehensive evaluation of its appropriateness.

Ethical Considerations

The study was conducted in accordance with established ethical principles governing educational research. Prior to the conduct of the study, formal permission was obtained from the school head to access and utilize the official Grade 4 Mathematics lesson exemplars for academic and research purposes. In addition, informed consent was secured from all five Master Teachers who participated as expert evaluators. Each evaluator was adequately informed about the purpose of the study, the procedures involved, the voluntary nature of participation, and the right to withdraw from the study at any stage without penalty or adverse consequence.

Appropriate measures were likewise undertaken to ensure confidentiality and protect professional privacy throughout the research process. Evaluation forms, written comments, and all related records were anonymized to prevent the disclosure of personal or institutional identities and were stored securely for research use only. In the presentation and reporting of findings, no identifying information concerning the participants, learners, or the school was revealed. These ethical safeguards were observed to uphold transparency, accountability, and respect for the rights, dignity, and welfare of all individuals involved in the study.

Results and Discussion

Objective 1: Analysis of Grade 4 Mathematics Quarter 1 lesson exemplars

The official Grade 4 Mathematics Quarter 1 lesson exemplars were analyzed using note-based thematic analysis to determine their alignment, completeness, and instructional quality in relation to the MATATAG Curriculum competencies. The findings are presented according to three analytic dimensions: content, structure, and assessment.

Content analysis

The content analysis showed that the lesson exemplars generally followed the quarter sequence for Geometry and Measurement and Number Sense, with partial alignment to the intended competencies. Weeks 1–4 progressed from angles to plane figures and perimeter, while Weeks 5–8 focused on large whole numbers, place value, comparison, and estimation. However, key gaps were identified: differentiation of quadrilaterals was only partially addressed, and addition and subtraction up to 1,000,000 were omitted. Several lessons also emphasized procedural tasks over conceptual understanding, offered limited reinforcement and enrichment, and repeated competencies without increasing cognitive demand.

Week	Focus/Content	Strengths	Gaps	Possible Improvements
1–2	Angles; triangles and quadrilaterals	Clear MELC alignment; concrete and visual tasks; contextual examples	Limited reasoning, scaffolding, and differentiation	Add guided slides, demos, and comparison tasks
3–4	Perimeter of quadrilaterals and composite figures	Logical content build-up; real-life applications	Weak explanation of formula choice and shape combination	Use visual guides, tracing, and authentic tasks.
5–6	Reading, writing, comparing, ordering, and rounding whole numbers up to 1,000,000	Relevant real-life data; measurable objectives; clear place-value focus	Limited reasoning prompts; narrow rounding examples	Include verbal prompts, varied examples, and conceptual support
7–8	Repeated place-value lesson; estimation of sums and differences	Continued reinforcement; contextual estimation problems	Repetition with little added complexity; no direct computation	Increase complexity and connect estimation to computation

Table 1. Content Analysis of Grade 4 Mathematics Quarter 1 Lesson Exemplars

Structure analysis

The structure analysis indicated that the exemplars generally followed a logical sequence of tasks and reflected developmentally appropriate ordering of lessons. In geometry, the structure moved from recognition to application, while in number sense it progressed from place value to comparison, ordering, rounding, and estimation. This sequence supported coherence across the quarter. However, recurring structural limitations reduced the effectiveness of delivery. Worked examples were not consistently reinforced, visual supports were not always used to make thinking visible, and interactive or manipulative tasks were limited. In later lessons, repeated structures were retained without greater complexity. As a result, the exemplars provided continuity but only partial scaffolding for deeper mathematical reasoning and independent review.

Wee k	Content	Strength	Gaps	Possible Improvement
1–2	Angles; triangles and quadrilaterals	Clear progression and use of classroom visuals	Worked examples and classification modeling were limited	Use reusable digital slides and visual classification guides
3–4	Perimeter of quadrilaterals and composite figures	From single-shape to composite-shape problems	No explicit visual tracing of perimeter paths; few interactive tools	Add labeled diagrams, drag-and-drop tasks, and reasoning prompts

5–6	Place value, comparing, ordering, and rounding	Logical flow from smaller to larger number representations	Activities remained largely procedural and weak in reflection	Integrate digit-shifting tasks and prompts for explaining order and rounding
7–8	Repeated place value; estimation	Consistency in lesson flow and contexts	Repetition without structural innovation; estimation isolated from exact computation	Add enriched tasks, number-line models, and estimate-versus-actual comparisons

Table 2. Structure Analysis of Grade 4 Mathematics Quarter 1 Lesson Exemplars

Assessment Analysis

The assessment analysis showed that most exemplar activities were aligned with the targeted competencies for each week. Tasks generally matched the intended content and included written computation, drawing, matching, and contextualized practice. This indicates that the exemplars attempted to preserve alignment between instructions and expected learning outputs. Nonetheless, assessment practices were narrow and weakly formative. Across the eight weeks, there were few embedded feedback mechanisms, no systematic use of rubrics or self-check tools, limited learner reflection, and minimal variation in assessment formats. Opportunities for oral explanation, authentic performance tasks, adaptive assessment, and progress monitoring were also limited. These patterns suggest that assessment alignment was present, but support for formative use and learner self-regulation remained insufficient.

Week	Focus/Content	Strengths	Weaknesses	Possible Improvements
1–2	Angles; triangles and quadrilaterals	Tasks matched objectives; some open-ended drawing work	No rubrics, limited reflection, little variation beyond written tasks	Add instant-feedback quizzes, self-check tools, and reflection prompts
3–4	Perimeter of quadrilaterals and composite figures	Computation tasks aligned with MELCs and contexts	No explanation prompts; feedback and authentic decisions were limited	Use adaptive problem sets and real-world performance tasks
5–6	Reading, writing, comparing, ordering, and rounding	Alignment with lesson goals and use of hands-on activities	No integrated feedback and limited student justification	Deploy low-stakes auto-checked quizzes and error-aware hint prompts
7–8	Repeated place value; estimation	Additional practice and realistic contexts	Redundant formats; no reflection on estimation accuracy	Increase complexity and require comparison of estimates with actual results

Table 3. Assessment Analysis of Grade 4 Mathematics Quarter 1 Lesson Exemplars

Objective 1 results showed that the lesson exemplars were sequential and partially aligned with the MATATAG Curriculum, but they lacked the necessary depth and breadth for full competency development, particularly in content coverage, structural scaffolding, and formative assessment support.

Objective 2: Design of the Google Classroom platform

The design phase translated the gaps identified in Objective 1 into a structured Google Classroom prototype organized around content support, lesson structure, learner interaction, and assessment. The design was framed through an input-process-output logic in which exemplar gaps served as inputs, pedagogical and technological design actions served as processes, and classroom features served as outputs. The resulting design included content-oriented features such as the Lesson Slide Archive, Lesson Videos, Formula Vault, Visual Learner's Corner, and MathLab Apps; structure-oriented features such as MathTalk Live, MathTalk Assistance, and MathTalk Replay; and assessment-oriented features such as TaskFolio, FlashQuiz, Assignment, Adaptive Learning Tasks, and Reflection Hub. Collectively, these features were designed to improve content accessibility, model mathematical thinking, increase opportunities for guided interaction, and strengthen formative assessment and learner reflection.

Component	Feature	Instructional Function	Gap Addressed
Content	Slide Archive; Videos; Formula Vault	Organized explanations and review resources	Limited examples, weak review access, shallow conceptual support
Content	Visual Corner; MathLab Apps	Visual and interactive concept representations	Few exploratory tasks and minimal multimodal resources

Structure	MathTalk Live; Assistance; Replay	Guided discussion, help, and lesson revisiting	Insufficient scaffolding, reasoning support, and access to explanations
Assessment	TaskFolio; FlashQuiz; Assignment; Adaptive Tasks; Reflection Hub	Feedback, varied assessment, monitoring, and reflection	Weak formative assessment, little differentiation, and limited self-regulation support

Table 4. Google Classroom Design Features

These results addressed Objective 2 by showing that the Google Classroom design was not assembled as a generic digital repository. Instead, each feature was deliberately matched to a specific instructional gap identified in the lesson exemplars.

Objective 3: Development and refinement of Google Classroom Version 2

For Objective 3, Version 1 of the Google Classroom prototype was evaluated by five purposively selected Master Teachers, and their ratings and suggestions guided the refinement of Version 2. Across the reviewed features, Version 1 was generally rated from Appropriate to Very Appropriate. Features such as MathTalk Replay, Assignment, and Adaptive Learning Tasks obtained the highest mean ratings, while Lesson Videos, MathTalk Assistance, TaskFolio, and FlashQuiz were identified as needing stronger engagement, structure, or variation. Version 2 incorporated these recommendations by adding interactive self-check items to slide archives, timestamped notes to videos, regular teacher-led problem-solving sessions, structured peer prompts, guided reflection prompts, automated progress tracking, multi-step problem-solving items, flexible assignment formats, gamified challenges, and additional resources such as the Formula Vault, Video Tutorials and MathLab Apps.

Panel A. Version 1 Mean Rating		**Panel B. Findings to Refinements**	
Feature	**Mean Rating**	**Findings**	**Refinement in Version 2**
Lesson Slide Archive	Very Appropriate $\underline{x}$ = 2.6	Static materials limited engagement.	Added interactive self-check questions.
Lesson Videos	Appropriate $\underline{x}$ = 2.2	Passive viewing reduced engagement.	Added timestamped notes and key takeaways.
MathTalk Live	Very Appropriate $\underline{x}$= 2.6	No structured teacher-led problem solving.	Scheduled regular teacher-led sessions.
MathTalk Assistance	Appropriate $\underline{x}$ = 2.2	Peer discussion lacked structure and clarity.	Introduced structured discussion prompts.
MathTalk Replay	Very Appropriate $\underline{x}$= 2.8	Little guided reflection on recorded discussions.	Added reflection prompts for analysis.
TaskFolio	Appropriate $\underline{x}$= 2.0	No progress tracker for submissions.	Introduced automated progress tracking.
FlashQuiz	Appropriate $\underline{x}$= 2.2	Items focused mainly on procedures.	Included multi-step problem-solving items.
Assignment Section	Very Appropriate $\underline{x}$= 2.8	Limited flexibility in submission formats.	Allowed varied assignment formats.
Adaptive Learning Tasks	Very Appropriate $\underline{x}$= 2.8	Needed stronger motivation and engagement.	Added gamified challenges and progress tracking.
Progress Point	Very Appropriate $\underline{x}$ = 2.6	Limited teacher and peer feedback options.	Added structured teacher and peer feedback.
Formula Vault	Not in Version 1	New feature introduced in Version 2.	Added visual aids and interactive practice examples.
Video Tutorials	Not in Version 1	New feature introduced in Version 2.	Added multiple video options and from different sources
MathLab Apps	Not in Version 1	New feature introduced in Version 2.	Embedded games and practice tools.

■ Appropriate (1.50-2.49) ■ Very Appropriate (2.50-3.00) ■ Highest Version 1 rating | Mean appropriateness rating (3-point scale)
Table 5. Version 1 Feature Ratings and Version 2 Refinements

Table 5 presents the mean ratings assigned to the Version 1 Google Classroom features and the corresponding qualitative feedback that informed the refinement of Version 2. Panel A indicates that the evaluated features received mean ratings ranging from 2.0 to 2.8, reflecting levels of appropriateness from Appropriate to Very Appropriate. Panel B complements these quantitative results by summarizing the identified gaps in Version 1, which served as the basis for targeted improvements in content delivery, learner support, and assessment-related features in Version 2.

To clarify how the refined LMS was organized within Google Classroom, the following graphical user interface (GUI) mockups are presented as design illustrations of the developed features. The figures visually complement Table 4 and 5 by showing how the identified instructional needs were translated into specific platform components and how selected Version 2 refinements were arranged within the LMS. These figures are included to clarify design implementation and layout.

The first set of mockups corresponds to the content-access features that were intended to improve lesson review, catch-up opportunities, and conceptual reinforcement.

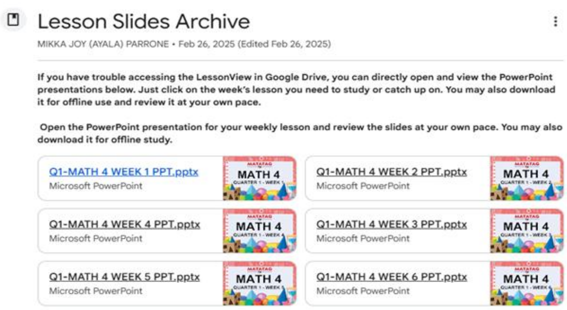

Figure 1. Lesson Slide Archive

The Lesson Slide Archive was developed to give pupils easy access to weekly Mathematics 4 lesson slides for review and catch-up. Figure 1 shows the archive in Google Classroom, where weekly PowerPoint lessons are organized and accessible in one section. This feature improved content accessibility by allowing learners to review lessons at their own pace. In Version 2, interactive self-check activities were added to make the archive more engaging and to reinforce learning.

This is supported by Table 5, where the feature was rated Very Appropriate (M = 2.6). Although Version 1 used mostly static materials, Version 2 addressed this gap by adding interactive elements on each slides to increase engagement.

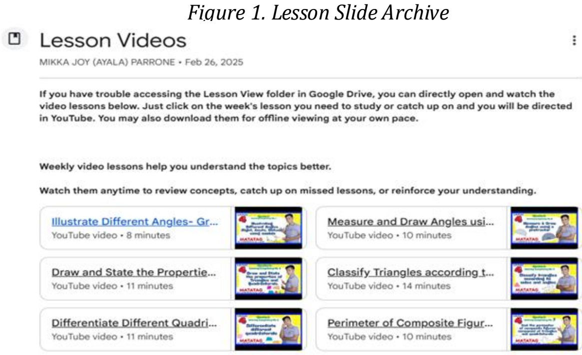

Figure 2. Lesson Videos

The Lesson Videos feature was developed to give pupils easy access to weekly Mathematics 4 video lessons for review and catch-up. Figure 2 shows the video archive in Google Classroom, where weekly video lessons are organized and accessible in one section. This feature improved content accessibility by allowing learners to revisit explanations and demonstrations at their own pace. In Version 2, timestamped notes and key takeaways were added to make the videos more engaging and to support quick review and comprehension.

The feature was rated Very Appropriate (M = 2.2). Although Version 1 lacked engagement features and made viewing mostly passive, Version 2 addressed this gap by adding review prompts and guided highlights to improve understanding.

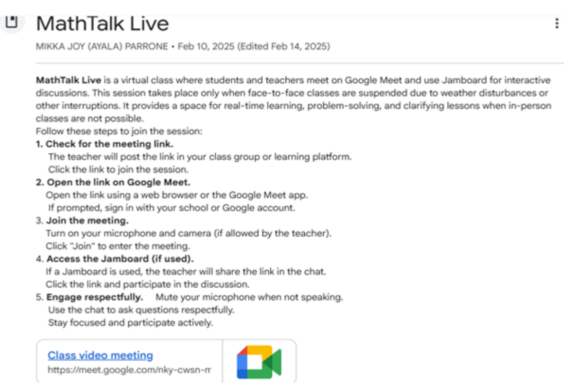

Figure 3. MathTalk Live

The MathTalk Live feature was designed to provide pupils with a space for real-time Mathematics 4 discussions when face-to-face classes are not possible. Figure 3 shows this feature in Google Classroom, where pupils can access a class video meeting link and follow guided steps for joining synchronous sessions. This feature supported immediate interaction, clarification of lessons, and collaborative problem-solving during class interruptions. In Version 2, structured teacher-led problem-solving sessions were incorporated to make discussions more focused and effective.

The feature was rated Very Appropriate (M = 2.6). Although Version 1 already offered live discussion opportunities, it lacked structured teacher facilitation for problem-solving. Version 2 addressed this by integrating regular teacher-led sessions to improve the quality of interaction.

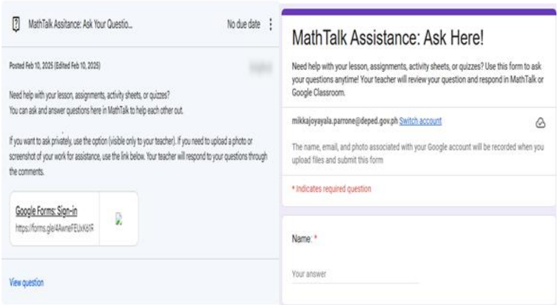

Figure 4. MathTalk Assistance

The MathTalk Assistance feature was created to provide pupils with a space to ask questions about lessons and tasks. Figure 4 shows this feature in Google Classroom, where pupils can seek help from classmates or the teacher. This feature improved learner support by making assistance more accessible within the platform. In Version 2, discussion prompts were added to encourage more meaningful interaction.

This is supported by Table 5, where the feature was rated Very Appropriate (M = 2.2). Although Version 1 allowed peer discussion, interaction was not well structured. Version 2 addressed this by adding guided prompts to improve the quality of discussion.

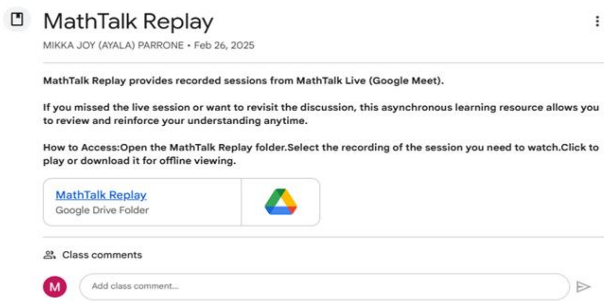

Figure 5. MathTalk Replay

The MathTalk Replay feature provided pupils with access to recorded MathTalk Live sessions for asynchronous review. This feature supported learning continuity by allowing learners to revisit explanations at their own pace. In Version 2, reflection prompts were added to guide learners' review of recorded discussions.

As shown in Table 5, the feature was rated Very Appropriate (M = 2.8). While Version 1 focused on access to recordings, Version 2 enhanced the feature by integrating prompts that supported more meaningful reflection.

The succeeding figures present the assessment, task-management, differentiation, and monitoring tools that extended the LMS beyond content delivery and strengthened formative support within the platform.

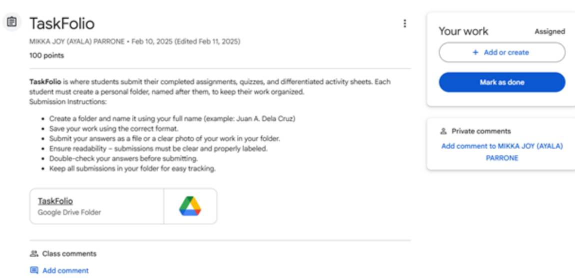

Figure 6. Task Folio

The TaskFolio feature was developed as a centralized space for submitting and organizing pupils' Mathematics 4 outputs. This feature improved task management by helping learners keep submissions organized and traceable. In Version 2, automated progress tracking was introduced to support monitoring of submissions.

This is supported by Table 5, where TaskFolio was rated Appropriate (M = 2.0). Although Version 1 allowed structured submission, Version 2 strengthened the feature by adding progress-tracking functions to improve learner accountability.

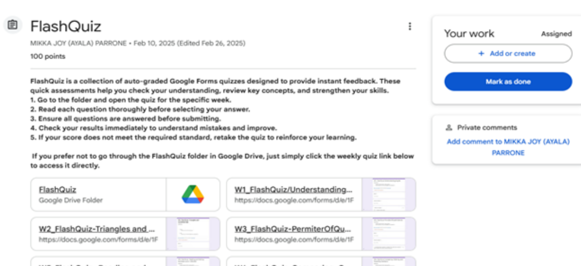

Figure 7. Flash Quiz

The FlashQuiz feature provided pupils with short, auto-graded quizzes for practice and immediate feedback. This feature supported formative assessment by allowing learners to check their understanding of key concepts. In Version 2, multi-step problem-solving items were incorporated to deepen learning.

Based on Table 5, FlashQuiz received an Appropriate rating (M = 2.2). While Version 1 emphasized procedural practice, Version 2 addressed this limitation by adding problem-solving items to promote conceptual understanding.

The Assignment feature was developed to connect Mathematics 4 lessons to real-life contexts and provide structured weekly tasks. This feature supported independent learning by allowing pupils to complete and submit tasks at their own

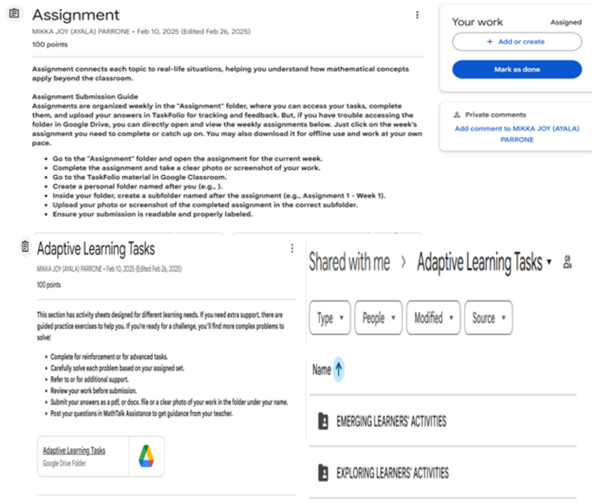

Figure 9. Adaptive Learning Tasks

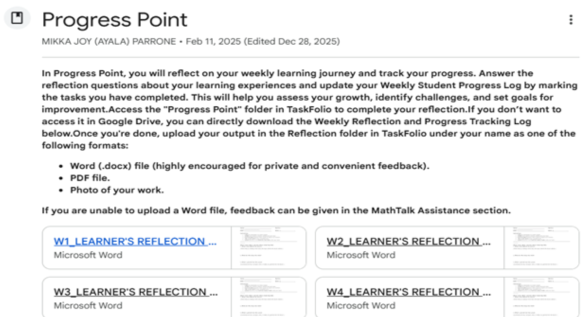

Figure 10. Progress Point

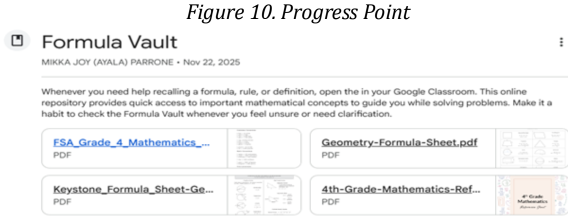

Figure 11. Formula Vault

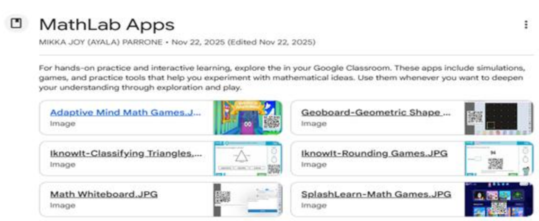

Figure 12. MathLab Apps

pace. In Version 2, clearer submission guidelines and improved integration with TaskFolio were implemented to enhance organization and feedback.

As indicated in Table 5, the feature was rated Very Appropriate (M = 2.8). While Version 1 limited flexibility in submission, Version 2 addressed this by allowing varied formats and improving learner engagement.

The Adaptive Learning Tasks feature was designed to address diverse learner needs through differentiated activity sets. This feature supported reinforcement and enrichment by providing guided practice for struggling pupils and more complex tasks for advanced learners. In Version 2, progress-tracking elements and interactive exercises were added to enhance motivation.

This is supported by Table 5, where the feature received a Very Appropriate rating (M = 2.6). Although Version 1 offered differentiated tasks, Version 2 strengthened engagement by incorporating interactive and trackable learning activities.

The Progress Point feature was developed to promote learner reflection and self-assessment through weekly progress logs. This feature supported metacognitive development by encouraging pupils to monitor their learning and set improvement goals. In Version 2, structured teacher feedback and peer evaluation options were integrated to enhance reflection.

Based on Table 5, the feature was rated Very Appropriate (M = 2.6). While Version 1 provided limited feedback options, Version 2 improved reflective practice through structured feedback mechanisms.

The Formula Vault was added in Version 2 to address learners' difficulty in recalling formulas and definitions identified in Version 1.

This feature provided a centralized repository of Mathematics 4 reference materials for quick consultation during problem solving, supporting accuracy and independence in learning, and served as an on-demand support tool that reduced cognitive load during task completion.

The MathLab Apps feature was introduced in Version 2 to enhance engagement and conceptual understanding, responding to the need for more interactive learning experiences in Version 1.

This feature offered hands-on simulations and educational games that allowed pupils to explore mathematical concepts through practice and visualization.

Discussion

The findings of the study indicate that the official Grade 4 Mathematics Quarter 1 lesson exemplars provided a usable instructional base but did not fully satisfy the curriculum demand for coherent competency coverage, conceptual depth, and formative support. Across content, structure, and assessment, the recurring pattern was not the absence of instructional intent, but the incompleteness of support mechanisms needed for sustained learner understanding. This pattern is consistent with the view that competency-based mathematics instruction must connect procedures with explanations, guided practice, and meaningful feedback rather than relying on isolated task completion alone.

For Objective 1, the omission of specific competencies, the repetition of selected lessons without increased complexity, and the limited use of reasoning prompts suggest that the exemplars only partially operationalized the mastery orientation of the MATATAG Curriculum. The content findings particularly show that curriculum alignment must be examined not only in terms of topic presence but also in terms of depth, reinforcement, and progression. The structural and assessment findings reinforce this interpretation because lessons that are sequential but weakly scaffolded may preserve order without necessarily advancing understanding.

For Objective 2, the design of the Google Classroom platform demonstrates that the identified shortcomings can be translated into targeted digital responses. Features such as archived slides, recorded videos, formula repositories, live discussion spaces, adaptive tasks, and feedback-rich quizzes directly map onto the observed need for review access, visual explanation, differentiated support, and formative assessment. This indicates that technology integration is most defensible when it is driven by diagnosed instructional problems rather than by platform availability alone.

For Objective 3, the development of Version 2 highlights the value of expert-based refinement. The revisions strengthened interaction, guidance, assessment variety, and learner monitoring, moving the platform toward a more learner-responsive instructional environment.

The findings carry theoretical, practical, and methodological implications. They support integrated design of content access, structural scaffolds, and formative assessment; they show that Google Classroom may be used for guided discourse, differentiated practice, and progress tracking; and they illustrate how thematic analysis, design mapping, and expert validation can be combined in curriculum-aligned instructional development.

At the same time, the study has limitations. The analysis focused only on the officially released Grade 4 Mathematics Quarter 1 exemplars, and the expert evaluation involved a small purposive group of Master Teachers. The findings therefore establish design validity and instructional rationale more strongly than broad effectiveness across contexts. Future studies may test the platform through classroom implementation, learner outcome data, usability evidence from teachers and pupils, and comparative analysis across additional grade levels or quarters.

The results and discussion show that the study objectives were met. Objective 1 identified the major strengths and gaps of the lesson exemplars. Objective 2 transformed those findings into a structured Google Classroom design. Objective 3 refined that design through expert-informed development. In combination, these outcomes support the conclusion that a carefully designed Google Classroom-based learning management system can serve as a curriculum-aligned response to the identified weaknesses of the Grade 4 Mathematics lesson exemplars.

Conclusion and Recommendations

Conclusions

This study examined three interrelated concerns: the adequacy of the Grade 4 Mathematics lesson exemplars, the design of a Google Classroom aligned with Mathematics 4 competencies, and the refinement of that platform through expert input. Viewed together, the results show that the printed exemplars provided instructional order and procedural practice, but they did not consistently cultivate conceptual understanding, differentiated support, authentic application, or formative assessment. These gaps established a clear need for a complementary digital environment that could extend the exemplars and strengthen mathematics instruction.

With respect to the first objective, the analysis indicates that the lesson exemplars were useful as baseline teaching resources but were not sufficient, in their present form, to fully support mastery of the intended MATATAG competencies. Their strengths were evident in the sequencing of lessons, the use of visual aids, and the provision of guided practice. However, important weaknesses remained, including incomplete treatment of some competencies, overreliance on routine procedural tasks, limited opportunities for mathematical reasoning and justification, and the absence of consistent formative feedback mechanisms. The study therefore concludes that exemplar-based instruction can sustain basic procedural performance, but stronger conceptual depth and transfer require more deliberate cognitive progression, broader assessment formats, and adaptive scaffolds for diverse learners.

For the second objective, the initial design of Google Classroom confirmed that a digital platform can respond meaningfully to weaknesses in classroom materials when it is intentionally tied to curriculum competencies. Version 1 established an organized and accessible learning space through lesson archives, lesson videos, synchronous and asynchronous interaction, portfolios, quizzes, adaptive tasks, and reflective features. Even so, expert evaluation revealed that organization alone did not guarantee deeper learning. Several components remained too static, collaboration needed clearer structure, and assessment options required expansion beyond basic procedural recall. Thus, the study concludes that Google Classroom becomes pedagogically significant only when its features are deliberately designed to promote interactivity, guided collaboration, varied demonstration of learning, and visible feedback.

For the third objective, the development of Version 2 demonstrates that expert-informed refinement can substantially improve the instructional value of a digital classroom. The addition of embedded self-checks, formula support, multiple video explanations, interactive applications, visual learning resources, structured live-session agendas, guided peer discussion, progress indicators, reflective prompts, and flexible assessment formats created a more coherent environment for mathematics learning. These enhancements moved the platform beyond content storage and delivery toward a system that supports engagement, conceptual reinforcement, learner monitoring, and differentiated pathways for demonstrating understanding. The study therefore concludes that a carefully developed Google Classroom can function as a meaningful complement to face-to-face teaching by addressing limitations in content delivery, interaction, and assessment.

The findings address the research problem by showing that the limitations of static lesson exemplars can be mitigated through a structured and expert-validated digital learning design. The most important contribution of the study lies not only in the production of an improved Google Classroom, but in demonstrating that technology integration is most effective when grounded in curriculum alignment, multimodal support, formative assessment, and learner reflection. Although the enhanced platform still depends on teacher mediation, access to technology, and continued refinement, it offers a practical and context-sensitive pathway for strengthening Mathematics 4 instruction across varied school settings.

Implications

Theoretical implications arise from the study's confirmation that digital learning environments are most effective when instructional design, rather than platform presence alone, drives learning quality. The findings extend current understanding of technology integration in elementary mathematics by showing that conceptual development is strengthened when digital resources combine scaffolded content, multimodal representations, guided interaction, and formative feedback. In this way, the study contributes to the refinement of perspectives that link cognitive support, scaffolding, and formative assessment with technology-enhanced learning.

Practical implications are evident for teachers, school leaders, and curriculum developers. For teachers, the study offers a model for converting lesson exemplars into a more interactive and learner-responsive classroom experience through self-check activities, guided discussion prompts, reflective tasks, and flexible assessments. For school leaders and program planners, the findings support the adoption of structured digital environments as complementary tools for continuity of instruction, remediation, and enrichment, especially in settings where learners need repeated access to lessons and varied modes of practice. For curriculum developers, the results underscore the need to review exemplars not only for content coverage but also for conceptual rigor, differentiation, and assessment diversity.

Methodological implications center on the value of a phased development process. By beginning with document analysis, proceeding to expert evaluation, and then refining the intervention into a second version, the study demonstrates a practical pathway for developing educational platforms that are evidence-based and context-sensitive. Future studies may adopt this iterative approach when designing digital learning environments, particularly when the goal is to align instructional tools with curriculum competencies and classroom realities. The study also suggests that expert review is not merely a validation step, but a design mechanism that can reveal how organizational features should be converted into pedagogically meaningful supports.

The study shows that strengthening Mathematics 4 instruction requires more than providing materials or digital access; it requires purposeful design that helps learners think, apply, reflect, and progress. The improved Google Classroom illustrates how curriculum-responsive and expert-informed innovation can support more inclusive, engaging, and conceptually grounded mathematics learning. With sustained refinement and thoughtful implementation, such platforms can contribute to a stronger and more adaptive model of elementary mathematics education.

Recommendations

The Grade 4 Mathematics lesson exemplars should be further refined to ensure complete and coherent coverage of all Quarter 1 competencies, with particular attention to logical conceptual progression across lessons. Learning activities should move beyond repetitive execution of routine procedures and increasingly emphasize higher-order mathematical thinking, such as comparison, explanation, justification, and application of concepts in meaningful, real-life problem situations. This will help learners develop deeper conceptual understanding rather than surface-level procedural skills.

Formative assessment strategies should be systematically embedded throughout both the lesson exemplars and the Google Classroom platform. These should include self-check items, worked examples, reflection prompts, structured teacher feedback mechanisms, and progress-monitoring tools. Consistent use of formative assessment will allow teachers to identify misconceptions early and provide timely instructional adjustments, thereby supporting continuous learning improvement.

Future implementations of the Google Classroom–based instructional framework should continue to expand interactive and multimodal features, such as guided video lessons, visual mathematics representations, adaptive practice tasks, and structured collaborative discussion activities. These digital elements should remain closely aligned with curriculum standards and learner needs, ensuring that technology functions as an integral component of instruction rather than as a supplementary add-on.

Teachers who will implement the platform should be provided with sustained professional development focusing on digital instructional design, online formative assessment, feedback practices, and differentiated facilitation strategies. The effectiveness of the Google Classroom platform depends not only on the quality of its instructional materials but also on teachers' capacity to strategically mediate learning and support diverse learners in an online environment.

Future research should extend the present study by implementing the developed Google Classroom platform with actual Grade 4 learners using a pre-test/post-test research design to measure its impact on conceptual understanding, procedural fluency, and problem-solving skills. Comparative studies between the developed learning management system and traditional face-to-face instruction are recommended to provide stronger empirical evidence of effectiveness.

To enhance methodological rigor, future validation studies may involve a larger panel of expert evaluators (e.g., 10–15 experts) and include reliability testing of evaluation instruments, such as Cronbach's alpha. Additionally, research incorporating usability testing, learner feedback, and achievement data from classroom implementation would strengthen the evidence base.

Finally, the instructional framework may be adapted and evaluated across other quarters (Q2, Q3, Q4) and different grade levels (Grades 3, 5, and 6) to determine its scalability and broader applicability. Further studies may also examine which specific Google Classroom features most strongly contribute to learning gains, engagement, and usability across diverse learner populations and school contexts.

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Competing Interests Statement

The author affirm that no competing interests exist that may have affected the integrity, analysis, or presentation of the work reported in this article.

Data Availability Statement

Supporting data for this study are available from the corresponding author upon reasonable request. Access may be granted in accordance with ethical safeguards, institutional policies, and the responsible use of research materials.

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Appendices

No appendices are attached to this study.