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# Developing a remediation tool to address learning gaps in numbers and number sense

Dante C. Cara [1], Analyn M. Gamit [2,*], Angelo R. Santos [2]

[1]Mathematics Department, Umangan National High School, Aliaga, Nueva Ecija, Philippines
[2]Graduate School, Nueva Ecija University of Science and Technology, Cabanatuan City, Philippines

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ABSTRACT

This study aimed to develop a remedial learning tool called the Learner's Packet for Grade 7 Mathematics, specifically to support students who have difficulty with Numbers and Number Sense. Using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation), the researchers identified learning gaps and created a structured material to address these weaknesses. The tool was reviewed by experts and tested using a pretest-posttest method, showing that most students improved from Low Mastery to Average Mastery in six out of seven skill areas. Although the results did not meet the Department of Education's official passing rate, students found the tool to be useful, engaging, and suitable for their needs. The study recommends improving the tool's usability, developing similar materials for other math topics, and conducting long-term research to support better learning outcomes.



## 1. Introduction

Mathematics is not only a cornerstone of academic learning but also a vital tool that shapes individuals' abilities in reasoning, problem-solving, and decision-making. It equips learners with critical and logical thinking skills essential for navigating daily life and excelling in diverse professional fields. Mathematics permeates various real-life situations, from managing finances to understanding technological advancements and scientific innovations (Khatri, 2011). Mastery of fundamental mathematical concepts provides a strong foundation for tackling more advanced topics, enabling students to progress in their academic and professional pursuits.

At the secondary education level, mathematics curricula globally emphasize fostering computational skills, conceptual understanding, and the ability to approach problems from multiple perspectives. In the Philippines, the K to 12 curriculum integrates mathematics as a core subject, aiming to enhance critical thinking, problem-solving abilities, and numeracy skills. This curriculum seeks to equip students with competencies that align with the demands of a 21st-century global economy (Khatri, 2011). However, despite these curricular reforms, challenges persist in achieving high proficiency levels across the student population, particularly in mathematics.

Historically, the Philippine educational system has undergone significant curricular revisions. The introduction of the Secondary Education Development Program (SEDP) in 1988 marked a shift towards a student-centered approach, followed by the Revised Basic Education Curriculum (RBEC) in 2002. These initiatives aimed to enhance the quality of education, culminating in the K to 12 programs implemented in 2013. This program extended basic education by two years and emphasized critical thinking and problem-solving, particularly in mathematics. Despite these efforts, Filipino students consistently exhibit low performance in mathematics, as evidenced by international assessments like the Programme for International Student Assessment (PISA) and the Global Competitiveness Report (OECD, 2023).

In the 2018 PISA, Filipino students ranked second to last in mathematics and science among 79 participating countries, with scores significantly below the OECD average (OECD, 2023). This trend persisted in the 2022 PISA assessment, where Filipino students scored 355 points in mathematics, compared to the OECD average of 472. These international results mirror outcomes from national

* Corresponding Author.
Email Address: amgamit2000@ineust.ph.education (A. M. Gamit)
https://doi.org/10.21833/ijaas.2025.06.016
Corresponding author's ORCID profile:
https://orcid.org/0000-0003-4266-0851

assessments like the National Achievement Test (NAT), revealing that many students fail to meet the required proficiency levels in mathematics.

A closer examination of the results highlights that a substantial number of students struggle with fundamental mathematical concepts, particularly in Numbers and Number Sense. This critical content area encompasses basic operations, estimation, number properties, and problem-solving—essential components for building a solid foundation in mathematics (Morrison et al., 2019). In the Aliaga District, Nueva Ecija, the 2022–2023 Regional Diagnostic Assessment indicated that only 28.38% of Grade 7 students passed their mathematics exams, with similar findings from the Regional Mid-Year Assessment, which recorded a passing rate of 47.94%. These figures underscore the systemic nature of the problem, as students' difficulties in foundational concepts cascade into future learning challenges (Maruyama and Kurosaki, 2021).

Existing remediation strategies in mathematics education often rely on teacher-led interventions, worksheet-based drills, or technology-assisted tutorials, which, while effective in addressing basic competency gaps, frequently neglect the diverse learning styles of students and fail to integrate real-world applications. This study innovatively proposes a learner-centered remediation tool that incorporates active learning strategies, formative assessments, and contextual problem-solving tasks. Such an approach aligns closely with contemporary educational theories emphasizing constructivist learning and student autonomy, which have been shown to enhance engagement and understanding (Atteh, 2022; Angraini et al., 2024). The importance of scaffolding techniques and interactive activities cannot be overstated, as they enable learners to internalize concepts more effectively (Khasawneh et al., 2022). Effective interventions are essential, particularly in Grade 7 Mathematics, as this stage lays the foundation for advanced learning in secondary education (Davis and Abass, 2023). The emphasis on "Numbers and Number Sense" is particularly strategic, aligning with curriculum standards and addressing specific areas of identified student difficulty. Without such focused interventions, many students risk facing prolonged academic challenges that traditional instructional methods may exacerbate (Thapa, 2023).

This study aims to fill existing gaps by developing a remediation tool called the Learner's Packet. This tool is designed to help students who struggle with basic concepts in Numbers and Number Sense. Unlike traditional remedial methods that focus mainly on repetitive exercises or teacher-led instruction, the Learner's Packet includes real-life examples, self-paced learning, and interactive problem-solving tasks. It uses a structured but flexible approach, allowing students to learn at their own pace while receiving focused support. The development of the tool follows the ADDIE framework, which ensures systematic design and improvement through empirical testing. Unlike fixed traditional materials, this tool is tested and improved using expert feedback, as well as pretest and posttest results. The study aims to offer an evidence-based approach to improving mathematics education in the Philippines. Strengthening basic math skills is important not only for students' academic success but also for helping the country stay competitive in the global economy, where numeracy is essential for innovation and progress (Maruyama and Kurosaki, 2021).

The development of the Learner's Packet is grounded in several key educational theories. Vygotsky's Zone of Proximal Development (ZPD) underpins the tool's scaffolding approach, ensuring that students engage in tasks slightly beyond their current mastery level with guided support (Kozulin, 2003). Cognitive Load Theory (Sweller, 2011) informs the tool's structured design, ensuring that content is presented in a way that reduces extraneous cognitive burden while enhancing retention. Furthermore, self-determination theory supports the tool's emphasis on motivation and engagement, as the self-paced format encourages students to take ownership of their learning. These theoretical foundations provide a robust framework for understanding the tool's impact on mathematical remediation and student learning outcomes.

Mathematics, recognized as a formal science, extends beyond mere calculations and theories; it is essential for fostering critical thinking and problem-solving skills. Current educational paradigms emphasize the shift from traditional rote memorization to active engagement in mathematics through practical applications. This shift is supported by studies indicating that integrating problem-solving techniques enhances students' mathematical fluency and reasoning abilities (Putra et al., 2022; Popova et al., 2022). Moreover, the incorporation of innovative methodologies, such as Realistic Mathematics Education (RME), has been shown to significantly improve students' problem-solving competencies (Da, 2023).

The ability to apply mathematical concepts to real-life scenarios is essential in developing analytical skills and logical reasoning, allowing students to navigate complex problems effectively. This trend reflects a broader educational commitment to not only improving mathematical understanding but also cultivating critical thinkers equipped for future challenges (Telaumbanua et al., 2023).

Identifying common challenges in mathematics is crucial for effective remediation, as early recognition enables the development of adaptive resources that address specific learning needs. Studies indicate that timely interventions can help reduce knowledge gaps and enhance continuous learning progression (Yoong and Hoe, 2022). Furthermore, aligning remediation efforts with educational standards supports curriculum goals and prepares students for standardized assessments, ensuring a cohesive learning experience (Murtiyasa and Lathifah, 2023). In addressing these challenges, educators can create

a dynamic and responsive learning environment. Implementing strategies that consider students' emotional resilience and learning difficulties allows for a more personalized approach to teaching mathematics. This tailored approach helps empower students to overcome their struggles and fosters a sense of agency in tackling difficulties that may arise during their learning journey (Khanal, 2022). By focusing on the analysis of students' challenges, educators can effectively enhance the overall quality of mathematics education, ensuring that all students can succeed (Panjaitan and Juandi, 2024).

Understanding learning barriers is equally significant in tailoring effective remediation strategies. Math anxiety can negatively impact performance and requires strategies to foster a supportive learning environment. Maruyama and Kurosaki (2021) emphasized the role of motivation in overcoming barriers and identified social dynamics as another influential factor.

Optimizing usability and experience in Grade 7 mathematics remediation is essential for enhancing both engagement and effectiveness. Prior research emphasizes the need for inclusivity to address diverse learning needs, ensuring that remediation tools cater to all students (Du and Lipscomb, 2023). Improved usability has been shown to promote better information retention and facilitate smoother learning pathways, ultimately aiding in knowledge acquisition (Masengesho and Andala, 2024). Features such as user-friendly dashboards and progress reports are critical, allowing educators to monitor and guide students effectively throughout their learning journey (Douglas et al., 2023). An optimized learning environment fosters collaboration, participation, and a proactive approach to mathematics remediation, characteristics that are vital for student engagement (Ran and Lin, 2022). Developing such a remediation tool necessitates a system that accurately identifies and addresses individual learning gaps, underscoring the importance of personalized learning paths tailored to each student's unique style and pacing. The integration of scaffolding techniques within the design of these educational tools ensures that learners can progress at their own rate while receiving the support they need to succeed in mathematics (Sun, 2023).

In addition to traditional remedial methods, recent advancements in education technology have introduced AI-based and digital remediation tools that offer adaptive learning experiences. These tools leverage real-time data analytics to provide individualized feedback and targeted interventions, enhancing student engagement and mastery. Digital platforms, such as Khan Academy and AI-driven intelligent tutoring systems, have shown promise in improving mathematical proficiency through automated scaffolding and interactive assessments (Lu et al., 2022). However, while technology-enhanced remediation offers scalability and efficiency, some studies highlight concerns about accessibility and the digital divide, particularly in low-resource educational settings. This study positions itself within this discourse by developing a structured, learner-centered remediation tool that integrates aspects of personalized learning while maintaining accessibility for students in traditional classroom environments.

Real-world applications of mathematics enhance learning by demonstrating its relevance in daily life. Maruyama and Kurosaki (2021) highlighted the motivational benefits of connecting mathematical concepts to real-life scenarios. Cantor (2019) noted that real-world relevance enhances long-term retention. By integrating authentic assessments, students can apply mathematical concepts to practical problems, reinforcing their understanding and skills.

Instructional Design (ID) plays a pivotal role in creating effective learning experiences. Morrison et al. (2019) described ID as a systematic process aimed at enhancing learning outcomes. Reiser and Dempsey (2018) emphasized its dual role as both art and science, with iterative evaluations central to continuous improvement. Wang et al. (2013) highlighted ID's growing importance in academic contexts, particularly in interdisciplinary collaborations and innovative teaching practices.

Learner's Packets have emerged as an effective remediation tool for Grade 7 mathematics, primarily due to their adaptability in addressing specific learning gaps among students. Research indicates that these packets can be tailored to meet diverse student needs, promoting personalized learning experiences (Ajimudin and Mukuna, 2024). Engaging activities such as puzzles and real-world problem-solving tasks incorporated into these packets not only enhance student interest but also facilitate a better understanding of complex mathematical concepts (Soboleva et al., 2022). Additionally, the flexibility of Learner's Packets in both independent and group settings allows for collaborative learning opportunities, fostering communication and teamwork among students (Du and Lipscomb, 2023). Monitoring student progress is pivotal; timely feedback on performance plays a crucial role in correcting misconceptions and reinforcing proper problem-solving procedures. This immediate nature of feedback is essential in helping students adjust their learning strategies effectively, ensuring that they can advance confidently in their mathematical studies (Douglas et al., 2023). By integrating these elements, Learner's Packets not only address academic challenges but also cultivate a supportive learning environment conducive to student success (Masengesho and Andala, 2024).

Empirical studies further support the effectiveness of targeted interventions in mathematics education. Magayon and Tan (2016) highlighted the value of differentiated instruction in enhancing engagement and mastery, while Jamandron and Comighud (2020) showcased the effectiveness of Strategic Intervention Materials in improving proficiency. Jolejole-Caube et al. (2019) revealed the negative association between math

anxiety and performance, underscoring the need for remediation tools that address both cognitive and affective factors. Studies on electronic Strategic Intervention Materials (e-SIMs) also suggest their potential in enhancing academic performance, as evidenced in the Antipolo City study for Biology during the 2022–2023 school year.

The reviewed literature highlights the importance of structured remediation tools in addressing foundational learning gaps in mathematics. While many existing interventions focus on traditional worksheets or digital platforms, this study contributes by integrating structured, scaffolded learning with contextualized real-world applications. The use of the ADDIE model ensures that the remediation tool undergoes iterative improvements, making it adaptable and data-driven. Although the tool demonstrated measurable improvements in student performance, its effectiveness should be examined in comparison with AI-based or digital approaches to determine its long-term sustainability. Further research is needed to explore the intersection between low-tech and high-tech remediation solutions, particularly in resource-constrained educational environments.

## 2. Methodology

### 2.1. Research design

This study utilized a developmental research design, focusing on the systematic creation and refinement of a remediation tool for Grade 7 Mathematics, specifically addressing competencies in Numbers and Number Sense. Developmental research, as described by Richey and Klein (2013), involves designing instructional materials and programs to achieve consistency and effectiveness. The ADDIE Model was adopted as the framework for this study, guiding the process through its interconnected stages of Analysis, Design, Development, Implementation, and Evaluation. The cyclical nature of the ADDIE Model allowed for iterative improvements at each stage, ensuring that the remediation tool met the learning needs of its target audience while addressing specific challenges encountered by students.

### 2.2. Locale of the study

The research was conducted at Umangan National High School, situated in the Aliaga District, Nueva Ecija. Located in Barangay Umangan, this secondary school serves as an accessible yet distinct educational hub within the district. Covering 6,000 square meters, the school provides ample space for academic and extracurricular activities. Its enrollment as of December 2023 included 295 students, equally distributed across male and female learners at both junior and senior high school levels. With a committed teaching and administrative staff, the school offered an ideal environment for the development and implementation of the remediation tool, particularly given its capacity to integrate community support into educational initiatives.

### 2.3. Participants of the study

The participants were selected through purposive sampling to ensure relevance to the study's objectives. Five mathematics experts, including education program supervisors, department heads, master teachers, and an instructional materials writer, were involved in evaluating the remediation tool. Their expertise provided critical insights into its content, format, presentation, organization, and accuracy. Additionally, 20 Grade 7 students identified as non-numerates were selected from the total cohort of 54 students. While the sample size is relatively small, it was purposefully chosen to allow for focused intervention and in-depth analysis of individual learning progress.

The targeted selection ensured that only students with significant difficulties in Numbers and Number Sense were included, maximizing the relevance of the remediation tool. Future studies may expand the sample size to enhance the generalizability of the findings. These participants demonstrated significant difficulties in foundational mathematical concepts, including set theory, integer operations, and rational number manipulation, as identified in the first-quarter assessment. Their inclusion ensured that the remediation tool was tailored to address specific gaps in understanding and provide meaningful support.

### 2.4. Data gathering instruments

Multiple instruments were employed to collect data and address the research problems. The First Quarter Assessment results served as the basis for identifying the least learned competencies, providing a foundation for designing the remediation tool. The Expert's Evaluation Rating Sheet (EERS), adapted from the Department of Education's Learning Resource Management and Development System, was used to assess the tool's quality across several criteria, including content and accuracy. A teacher-made proficiency test was administered before and after the intervention to measure changes in student performance, while a usability questionnaire captured students' feedback on the tool's practicality and effectiveness. These instruments were carefully validated and refined with input from the researcher's adviser and educational experts to ensure reliability and alignment with the study's goals.

### 2.5. Data gathering procedure

The researcher followed a systematic approach in gathering data. Permission to conduct the study was obtained from school authorities, and participants

were briefed on the study's purpose. Informed consent was secured, emphasizing confidentiality and voluntary participation. The researcher personally administered and collected data, ensuring clarity in the instructions provided to participants. Throughout the development process, the ADDIE framework was used to guide activities. In the Analysis stage, learning competencies and student difficulties were identified based on the curriculum and assessment results.

During the Design stage, the format and components of the remediation tool were finalized, adapting elements from existing models to suit the context of Grade 7 Mathematics. The Development stage involved drafting and refining the tool with input from mathematics experts and the researcher's adviser. Implementation included pretests, posttests, and remedial sessions, during which students provided feedback through structured interviews. Finally, in the Evaluation stage, the tool's effectiveness was assessed by analyzing student performance and expert evaluations, with revisions made as necessary to enhance its quality and usability.

### 2.6. Data analysis techniques

The data collected during the study were analyzed using both descriptive and inferential statistical methods. The First Quarter Assessment results were examined to identify the least learned competencies, and students' mastery levels were classified based on a standardized scale. Pretest and posttest scores were analyzed using a paired sample t-test to assess performance improvements. Effect size calculations provided insight into the magnitude of improvement. Future studies may use ANCOVA or multiple regression to control confounding variables and enhance statistical rigor.

While this study lacked a control group, the paired design enabled direct measurement of individual progress. Future research may incorporate a control group to strengthen causal claims by comparing the tool with traditional remediation methods. Responses from experts and students were analyzed using Likert scales, with mean scores interpreted to assess the tool's quality and usability. These analyses provided a comprehensive understanding of the tool's impact and areas for further refinement.

### 2.7. Ethics considerations

Ethical principles were strictly adhered to throughout the study to ensure the integrity of the research process and the welfare of the participants. Informed consent was obtained from all participants, with clear communication of the study's objectives, potential risks, and benefits. Privacy and confidentiality were maintained in compliance with the Data Privacy Act of 2012, safeguarding personal information and ensuring anonymity in reporting results. The researcher prioritized transparency and professional integrity, conducting the study with honesty and rigor. Feedback from participants and experts was actively sought and incorporated to refine the remediation tool and align it with the needs of its intended users. By addressing these ethical considerations, the study ensured that the development of the remediation tool adhered to the highest standards of research ethics, contributing to its credibility and practical relevance.

## 3. Results and discussion

### 3.1. Description of the learning competencies of mathematics 7

The first quarterly assessment for Grade 7 Mathematics identified critical learning gaps in foundational competencies under Numbers and Number Sense, with all areas classified as Low Mastery (grand mean: 31.44%). The lowest competency was illustrating properties of operations on integers (23.90%), highlighting difficulties in commutativity, associativity, and distributivity. Students also struggled with solving problems using Venn diagrams (32.08%) and performing operations on rational numbers (30.57%), reflecting gaps in conceptual understanding and procedural application. The consistently low scores across competencies indicate the need for targeted remediation to strengthen foundational skills and prevent difficulties in advanced topics.

### 3.2. Design of the remediation tool for mathematics 7

The Learner's Packet was developed to address learning gaps in Mathematics 7 – Numbers and Number Sense, following a learner-centered approach aligned with the K-12 Basic Education Curriculum. It was designed to help students work independently at their own pace while reinforcing the Most Essential Learning Competencies (MELCs). The packet included structured learning phases—Introduction, Development, Engagement, and Assimilation—to ensure progressive mastery of concepts. The Introduction phase captured students' interest using stories or real-life contexts, while the Development phase provided concise explanations and examples. The Engagement phase allowed for independent practice, and the Assimilation phase encouraged real-world application of learned skills. Additional features such as evaluation tasks, reflection activities, and self-assessments helped students track progress and identify areas for improvement. Teachers also benefited from the structured design, which facilitated progress monitoring and instructional support. The development process involved assessing curriculum needs, identifying gaps, and curating resources based on assessment results. The packet was designed for flexibility, making it suitable for in-person, blended, and remote learning environments.

### 3.3. Development of the remediation tool for mathematics 7

The Mathematics 7 remediation tool on Numbers and Number Sense was developed to address the competencies identified as least mastered in the initial assessment. All seven competencies were classified as "Low Mastery," indicating significant learning difficulties among students. To address these gaps, ten remediation modules were created, each focusing on a specific competency using interactive activities, visual aids, real-life applications, and formative assessments. The structured design of the modules supported gradual and continuous learning.

Week 1A introduced sets, subsets, and set operations using familiar examples, while Week 1B used Venn diagrams and interactive tasks to support visualization. In Week 2, set theory was applied to real-world situations, such as analyzing weather patterns. The topic of integers was explored in Week 3A through financial examples to explain absolute value, and in Weeks 3B and 3C through storytelling, signed tiles, and practical examples like diving depths to teach operations. Week 4A employed visual models to demonstrate the properties of integer operations, while Week 4B introduced tools such as calculators and long division to support the conversion between fractions and decimals.

The final modules, Weeks 5A and 5B, focused on operations with rational numbers—addition, subtraction, multiplication, and division—through everyday situations such as budgeting and measurement. These real-life contexts helped improve understanding and memory, reinforcing the practical importance of rational number operations in daily life.

### 3.4. The developed remediation tool described by experts in terms of

#### 3.4.1. Content

The Mathematics 7 remediation tool received an overall mean score of 3.95, corresponding to an "Excellent" rating for its content. Experts noted that the tool was well-aligned with the Mathematics 7 curriculum, focusing on competencies where students showed the lowest levels of mastery. The content effectively addressed learning gaps by including appropriate examples, exercises, and formative assessments designed to meet students' specific needs. For example, modules such as “Week 1B: Operations on Sets” and “Week 3B: Addition and Subtraction of Integers” received high scores of 4.00 and 3.97, respectively, for their relevance to the targeted competencies. Experts also praised the inclusion of problem-solving tasks and real-life applications, which contributed to more meaningful learning and helped students better understand difficult concepts. In addition, the embedded formative assessments allowed teachers to track student progress and provide timely support, ensuring continuous learning and improvement.

#### 3.4.2. Format

In terms of format, the remediation tool received an overall mean score of 3.94, which was also rated as "Excellent." Experts highlighted the tool’s clear layout, logical progression, and user-friendly design. Modules such as “Week 1B: Operations on Sets” and “Week 5A: Adding and Subtracting Rational Numbers” achieved the highest mean scores of 3.99 and 3.98, respectively, due to their well-structured format and ease of use. These features helped both students and teachers navigate the materials effectively, supporting meaningful learning. Slightly lower scores, such as the 3.91 for “Week 4B: Expressing Rational Numbers from Fraction Form to Decimal Form and Vice Versa,” were attributed to the abstract nature of the content, indicating the importance of careful formatting to aid understanding. The consistent design throughout all modules was recognized as a key strength in promoting student engagement and comprehension.

#### 3.4.3. Presentation and organization

The overall mean score for presentation and organization was 3.91, earning another "Excellent" rating. Experts noted that the tool’s structured presentation and coherence played a significant role in improving students’ engagement and comprehension. Modules such as "Week 1A: Sets – An Introduction" and "Week 2: Problems Involving Sets" received perfect scores of 4.00 for their clarity and alignment with learning objectives. Even more complex modules, like "Week 3C: Multiplication and Division of Integers" and "Week 4A: Illustrating Properties of Operations on the Set of Integers," maintained high scores of 3.92 and 3.84, respectively. Features such as consistent headings, step-by-step instructions, and logical sequencing of activities were particularly praised for making the tool accessible and effective in facilitating learning.

#### 3.4.4. Accuracy and up-to-datedness of information

The accuracy and up-to-datedness of the remediation tool received the highest overall mean score of 4.00, earning an "Excellent" rating for all modules. Experts highlighted the rigorous validation process used to ensure that all content aligned with the current curriculum and educational standards. The inclusion of real-world examples and problems, such as "Week 5B: Multiplying and Dividing Rational Numbers," demonstrated the tool’s relevance and applicability to practical scenarios. This meticulous approach ensured that students were provided with accurate and reliable information, fostering confidence in their learning materials.

### 3.4.5. Summary of Expert Evaluation

The overall mean score for the remediation tool, based on the four evaluation criteria, was 3.95, with all aspects rated "Excellent." The high ratings validated the tool's effectiveness in addressing students' learning needs and enhancing their mastery of mathematical competencies. Each criterion contributed to the tool's success, from its well-aligned content and user-friendly format to its clear presentation and rigorous accuracy. These findings underscore the tool's potential to significantly improve students' learning outcomes in Mathematics 7.

## 3.5. Implementation of the developed remediation tool

The developed remediation tool for Mathematics 7 was implemented during the National Mathematics Program (NMP), a platform designed to provide focused remedial instruction. The sessions spanned 30 minutes daily from Tuesday to Friday, totaling two hours weekly. This schedule was intentionally structured to incorporate individual practice, collaborative group activities, and teacher-led discussions, fostering a balanced and comprehensive learning experience. The teacher-implementer, also the students' subject teacher, played a pivotal role in facilitating these sessions, ensuring that each learner received adequate support to address specific academic gaps.

Student feedback, gathered through interviews, highlighted the tool's effectiveness and unique instructional strategies compared to traditional classroom methods. The thematic content analysis of student responses revealed several critical themes regarding their experiences with the remediation tool.

## 3.6. Themes emerging from the implementation

### 3.6.1. Engagement and motivation

Students reported higher engagement and motivation while using the tool. Activities described as "fun," "engaging," and connected to real-life scenarios were noted to capture interest effectively. Features such as storytelling, visuals, and puzzles provided a dynamic approach to learning, making sessions enjoyable and stimulating. This finding aligns with studies emphasizing the role of active and interactive learning in enhancing academic engagement (Wentzel and Miele, 2009).

### 3.6.2. Effectiveness and learning outcomes

The remediation tool significantly contributed to improved learning outcomes, as students noted progress in areas they previously struggled with. The structured and targeted design of the activities helped clarify complex topics, enabling learners to develop confidence in their abilities. This effectiveness is consistent with findings by Gómez-García et al. (2021), who emphasized the importance of tailored instructional tools in bridging academic gaps and fostering skill mastery.

### 3.6.3. Sequential learning activities

A recurring observation among students was the systematic organization of the tool's activities. The sequential nature of the content, requiring learners to complete one task before moving on to the next, was highlighted as a key feature. This approach provided clarity and ensured that students built foundational knowledge incrementally.

### 3.6.4. Developmentally appropriate learning activities

Students appreciated the alignment of the tool's activities with their proficiency levels. Tasks were described as appropriately challenging yet manageable, with enough guidance to facilitate learning. Teachers carefully considered students' developmental needs, ensuring that activities were both engaging and achievable.

### 3.6.5. Self-paced learning

The remediation tool's flexibility allowed students to progress at their own pace, addressing specific areas of difficulty without feeling rushed. This feature helped build confidence and reduce anxiety, particularly for low-performing students. Research by Kim et al. (2021) underscored the benefits of self-paced models in fostering deeper understanding and improving academic outcomes.

### 3.6.6. Teacher's Guidance and Support

Students highlighted the importance of teacher involvement in the success of the remediation tool. Teachers provided structured guidance, emotional encouragement, and immediate feedback, creating a supportive learning environment. This finding aligns with Lee et al. (2018), who emphasized the critical role of teacher-student relationships in remedial education.

## 3.7. Level of performance of grade 7 students before and after exposure to remediation

The remediation tool aimed to address learning gaps in Mathematics 7: Numbers and Number Sense, particularly in the least mastered competencies. A 50-item teacher-made proficiency test measured student performance before and after the intervention. As presented in Table 1, results showed an increase in overall mean scores from 11.30 (22.60% - Low Mastery) in the pretest to 19.05 (38.10% - Average Mastery) in the posttest, reflecting a notable performance improvement. The

Mean Normalized Gain (MNG) was calculated at 0.15, indicating partial learning gains. Among the competencies, illustrating well-defined sets and set operations (LC1) showed the highest posttest performance level at 45% (MNG: 0.28), reflecting strong remediation effectiveness in this area. Other competencies, such as performing operations on rational numbers (LC7) and illustrating properties of integer operations (LC5), also improved significantly, with MNG values of 0.18 and 0.19, respectively. However, solving problems using Venn diagrams (LC2) showed the lowest improvement, with a pretest score of 23% rising slightly to 27.50% (MNG: 0.05), highlighting continued challenges in this area despite remediation efforts. Meanwhile, expressing rational numbers in fractional and decimal forms (LC6) showed notable progress, increasing from 29% to 42% (MNG: 0.13). Overall, the results confirm that the remediation tool effectively improved student performance, though some competencies require further reinforcement.

**Table 1:** Mathematics proficiency of students before and after exposure to remediation using the development remediation tools

| Learning competencies | Total items | Before exposure (pretest) | | | After exposure (posttest) | | | MNG |
|---|---|---|---|---|---|---|---|---|
| | | MS | PL (%) | DR | MS | PL (%) | DR | |
| LC1. The learners illustrate well-defined sets, subsets, universal sets, null set, cardinality of sets, union and intersection of sets, and the difference between two sets. | 10 | 1.70 | 17 | LM | 4.50 | 45 | AM | 0.28 |
| LC2. The learner solves problems involving sets with the use of a Venn Diagram. | 10 | 2.30 | 23 | LM | 2.75 | 27.50 | LM | 0.05 |
| LC3. The learner represents the absolute value of a number on a number line as the distance of a number from 0. | 3 | 0.80 | 26.67 | LM | 1.10 | 36.67 | AM | 0.10 |
| LC4. The learner performs fundamental operations on integers. | 7 | 1.85 | 26.43 | LM | 2.75 | 39.29 | AM | 0.13 |
| LC5. The learner illustrates the different properties of operations on the set of integers. | 5 | 0.85 | 17 | LM | 1.80 | 36 | AM | 0.19 |
| LC6. The learner expresses rational numbers from fraction form to decimal form and vice versa. | 5 | 1.45 | 29 | LM | 2.10 | 42 | AM | 0.13 |
| LC7. The learner performs operations on rational numbers. | 10 | 2.30 | 23 | LM | 4.05 | 40.50 | AM | 0.18 |
| Total | 50 | 11.25 | 22.50 | LM | 19.05 | 38.10 | AM | 0.15 |

96-100: Mastered; 86-95: Closely approximating mastery; 66-85: Moving towards mastery; 35-65: Average mastery; 15-34: Low mastery; 5-14: Very low mastery; 0-4: Absolutely no master

### 3.8. Difference between the pretest and posttest scores

The study utilized a paired sample t-test (two-tailed) to evaluate the statistical significance of the difference in Mathematics proficiency scores before and after the implementation of the remediation tool. Table 2 presents the results of the analysis. The analysis revealed a mean difference of -7.80 between the pretest and posttest scores, with a standard deviation of 2.59 and a standard error mean of 0.58. The computed t-value was -13.482, with a corresponding p-value of 0.000 at a 0.05 level of significance and 19 degrees of freedom. The 95% confidence interval for the difference ranged from -9.01 to -6.59. Given the p-value of 0.000, the results indicate a statistically significant difference between the pretest and posttest scores, leading to the rejection of the null hypothesis. These findings confirm that the remediation tool had a measurable positive impact on students' performance in Mathematics 7: Numbers and Number Sense.

**Table 2:** Paired samples test of mathematics proficiency test scores (Pretest and posttest)

| | Paired differences | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | 95% confidence interval of the difference | | | | |
| | Mean | Standard deviation | Standard error mean | Lower | Upper | T | Df | Sig. (2-tailed) |
| Pair 1 pretest-posttest | -7. 8000 | 2. 58742 | .57856 | -9.01095 | -6.58905 | -13.482 | 19 | .000 |

### 3.9. Usability of the developed remediation tool

The usability of the developed remediation tool, specifically the Learners' Packet, was assessed based on several indicators: simplicity, appropriateness, clarity, relevance, and its impact on learning outcomes. The evaluation revealed an average mean score of 3.72, corresponding to "strongly agree," indicating that students found the tool highly effective in supporting their learning in Mathematics 7: Numbers and Number Sense. The highest-rated indicator, with a weighted mean of 3.95, affirmed that the tool provided optimal opportunities for learners to achieve their learning objectives. Indicators such as the appropriateness of language, the accuracy of visual aids, and the tool's ability to engage and foster creativity also received high ratings of 3.80, reflecting strong student satisfaction. The tool's simplicity and user-friendliness were rated at 3.65, highlighting its accessibility and ease of use, while the clarity of instructions was rated 3.75, demonstrating that the guidance provided was clear and effective. The lowest-rated indicator, "learning and information design are easy to understand," received a weighted mean of 3.45, still within the "strongly agree" range, suggesting room for improvement in design simplification to enhance clarity. The difficulty level, rated at 3.55, confirmed that the tool was well-aligned with the capabilities of the target learners, providing an appropriate level of challenge.

### 3.10. Proposed implementation plan

In response to the study's findings, an implementation plan was proposed to ensure the effective deployment and utilization of the developed remediation tool for Mathematics 7. The plan focuses on three key objectives: providing teacher training and support, engaging students with the tool, and monitoring its effectiveness in improving learning outcomes.

#### 3.10.1. Providing teacher training and support

The primary objective is to equip teachers with the necessary skills and knowledge to utilize the remediation tool effectively. Workshops will be conducted to familiarize teachers with the tool and provide training on personalized learning strategies and differentiated instruction. These activities will be spearheaded by the Mathematics Department Head and subject teachers. Resources such as training materials and access to the tool will be provided. The initiative is scheduled year-round and will be supported by the school or department budget. Success will be measured by teachers' ability to effectively integrate the tool into their classroom practices.

#### 3.10.2. Engaging students with the remediation tool

The second objective focuses on promoting active student engagement with the remediation tool. Orientation sessions will be conducted to introduce the tool, followed by interactive sessions allowing students to explore its features. Individualized learning paths will be created based on students' pretest results to address specific gaps. The Mathematics Department Head and subject teachers will facilitate these activities, which will use the remediation tool and pretest results as core resources. This initiative is also planned year-round, supported by the school or department budget. Indicators of success include increased student engagement, positive feedback on usability, and visible improvements in students' participation during remedial sessions.

#### 3.10.3. Monitoring and assessing the tool's effectiveness

The final objective aims to ensure continuous improvement by monitoring the tool's impact on learning outcomes. Pretest and posttest assessments will be implemented to evaluate student progress, and feedback will be collected from teachers and students regarding the tool's performance. The Mathematics Department Head and subject teachers will analyze test results to identify improvements and areas for refinement. Resources required include test materials and results, and the activities will take place throughout the year, funded by the school or department budget. Success will be determined by significant improvements in posttest scores and positive feedback from both students and teachers.

This implementation plan is designed to address the identified learning gaps and maximize the tool's potential to enhance teaching and learning outcomes in Mathematics 7. By integrating training, engagement, and assessment, the plan ensures a systematic approach to achieving the desired educational improvements.

## 4. Discussion

The findings of the first quarterly assessment for Grade 7 Mathematics reveal persistent gaps in foundational competencies, particularly in Numbers and Number Sense, with an overall low mastery level (31.44%). The weakest areas, such as illustrating properties of integer operations (23.90%) and solving problems using Venn diagrams (32.08%), indicate students' struggles with abstract mathematical concepts and real-world applications. This aligns with Mousavi et al.'s (1995) argument that inadequate mastery of basic mathematical principles can overwhelm cognitive capacity, hindering progression to advanced topics. Furthermore, the findings suggest limitations in traditional teacher-centered instruction, reinforcing Morrison et al.'s (2019) emphasis on the need for student-centered, interactive learning strategies to enhance engagement and comprehension.

The remediation tool, designed as a Learner's Packet, effectively addressed learning challenges through a structured and progressive approach aligned with the DepEd K–12 Basic Education Curriculum. It followed four key phases—Introduction, Development, Engagement, and Assimilation—to support step-by-step knowledge building, which contributed to improved understanding and retention. The Development phase helped explain abstract concepts more clearly, while the Engagement phase provided hands-on activities that supported active learning and addressed common difficulties in retaining information. Furthermore, the inclusion of self-assessment and reflection sections enabled students to monitor their own progress, promoting deeper learning and supporting the development of essential skills.

The development of the remediation tool followed the ADDIE framework, ensuring systematic design, implementation, and refinement. Interactive activities, such as Venn diagrams for set operations and real-world budgeting exercises, helped connect mathematical concepts to practical scenarios, enhancing relevance and retention. The inclusion of scaffolded learning activities, storytelling, and manipulatives supported students in internalizing complex topics—a strategy advocated by Abrami et al. (2015), which emphasizes contextualized learning for better engagement.

Expert evaluations confirmed the effectiveness of the remediation tool, with high ratings in content, format, presentation, and accuracy. The alignment with curriculum standards and clear, well-structured modules facilitated ease of use for both students and teachers. Notably, the modules on operations with rational numbers were praised for their logical sequence and real-world applications. Furthermore, the rigorous validation process ensured the tool's reliability and relevance, fostering confidence among educators and learners. The implementation of the tool resulted in enhanced student engagement, motivation, and performance, as indicated by thematic analysis of student feedback. The tool's self-paced learning structure and interactive activities were particularly beneficial for struggling students, aligning with Vygotsky's Zone of Proximal Development theory (Kozulin, 2003), which emphasizes scaffolded support to help learners move beyond their current skill level. Additionally, teacher involvement was identified as a key success factor, providing both academic and emotional support, reinforcing findings by Wentzel and Miele (2009) on the role of teacher guidance in student persistence and achievement. A notable improvement in posttest performance—from Low Mastery (22.60%) to Average Mastery (38.10%)—demonstrates the tool's effectiveness in addressing key learning gaps. Targeted competencies such as set theory (LC1) and rational number operations (LC7) showed substantial learning gains, validating the structured approach to remediation. However, the limited improvement in LC2 (problems involving Venn diagrams) suggests a need for further enhancements, such as improved visual aids or alternative teaching strategies, as suggested by Gómez-García et al. (2021). The overall MNG of 0.15 indicates that while progress was made, continued remediation is necessary for higher mastery levels.

The usability evaluation revealed strong student satisfaction, with positive ratings in clarity, simplicity, and engagement. As noted by Sweller (2011), reducing cognitive load through user-friendly materials enhances learning effectiveness. However, opportunities for improvement remain, particularly in simplifying complex sections and refining the information layout for greater accessibility. Building on these findings, the proposed implementation plan focuses on teacher training, student engagement, and continuous assessment. By equipping educators with the skills to personalize instruction and actively involving students in the learning process, the plan ensures a sustainable, long-term approach to remediation. Ongoing monitoring and refinement will further enhance the tool's effectiveness, fostering equitable access to quality mathematics education for all students.

## 5. Conclusions

The study revealed significant insights into addressing the persistent learning gaps in Mathematics 7, particularly in Numbers and Number Sense. The consistently low mastery of all competencies during the First Quarterly Examination emphasized the necessity for targeted interventions to improve students' foundational understanding of mathematical concepts. The development of the Learner's Packet provided a learner-centered and structured tool designed to bridge these gaps effectively. By focusing on seven critical competencies and incorporating interactive activities, visual aids, and real-life applications, the tool succeeded in enhancing student engagement and comprehension. The remediation tool met the standards of the Learning Resource Management and Development System (LRMDS), with experts rating it highly across all evaluation criteria, including content, format, presentation, and accuracy. Its implementation demonstrated a noticeable improvement in students' performance, moving from Low Mastery to Average Mastery in six of the seven competencies. Although the students did not achieve the 75% passing rate set by the Department of Education, the statistically significant improvement in test and posttest scores validated the tool's effectiveness. Furthermore, students found the tool highly usable, citing its user-friendly design, engaging content, and appropriately challenging activities as instrumental in their learning progress. The proposed implementation plan highlighted a comprehensive strategy for deploying the tool, ensuring teacher preparedness, student engagement, and systematic monitoring to sustain improvements in educational outcomes. To enhance the impact of mathematics instruction and further address the identified gaps, the study suggests refining the remediation tool to better meet the needs of students. Strengthening interventions for specific competencies, such as solving problems with Venn diagrams, could address the areas where improvements were less pronounced. Simplifying the design and presentation of the tool is recommended to ensure clarity and reduce any potential barriers to understanding. Expanding the use of similar remediation tools for other mathematical topics and academic subjects may also support broader educational needs. Additionally, implementing continuous monitoring and evaluation will ensure the relevance and effectiveness of these tools over time. Future research should explore the long-term impacts of remediation tools on student performance and assess their adaptability across various educational contexts to maximize their potential in fostering academic success.

## 6. Limitations

This study is subject to certain limitations that may have influenced its outcomes. First, the sample size was relatively small, involving only 20 Grade 7 students and five expert validators, which may limit the generalizability of the findings. However, this focused approach allowed for an in-depth evaluation of the tool's effectiveness in a real classroom setting.

Future studies may expand the sample size and include students from multiple schools to strengthen the generalizability of results. Additionally, the research was conducted within a single school in Nueva Ecija, and its context-specific results may not fully apply to other schools or regions with different educational environments and resources. Moreover, the absence of a control group limits the ability to attribute performance improvements solely to the remediation tool. Future research should incorporate a control group to compare the tool's impact against traditional remediation methods and further validate its effectiveness. The study also focused solely on Numbers and Number Sense, excluding other key mathematical areas that could benefit from similar remediation tools. Lastly, the timeframe for implementation was constrained to a short duration, limiting the ability to assess the long-term impact of the remediation tool on student learning outcomes. Additionally, while a paired sample t-test was used to determine statistical significance, future research may benefit from employing ANCOVA or effect size calculations to strengthen the validity of the findings and account for potential confounding variables.

## List of abbreviations

| | |
|---|---|
| ADDIE | Analysis, design, development, implementation, and evaluation |
| AI | Artificial intelligence |
| AM | Average mastery |
| DR | Descriptive rating |
| EERS | Expert's evaluation rating sheet |
| ID | Instructional design |
| LC | Learning competency |
| LM | Low mastery |
| LRMDS | Learning resource management and development system |
| MELCs | Most essential learning competencies |
| MNG | Mean normalized gain |
| MOOC | Massive open online course |
| NAT | National achievement test |
| NMP | National mathematics program |
| OECD | Organisation for economic co-operation and development |
| PISA | Programme for international student assessment |
| PL | Performance level |
| RBEC | Revised basic education curriculum |
| RME | Realistic mathematics education |
| SEDP | Secondary education development program |
| ZPD | Zone of proximal development |

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## Compliance with ethical standards

### Ethical considerations

The study adhered to ethical research standards to ensure the integrity of the process and the welfare of participants. Information consent was obtained from all participants, including the students and their parents, as well as the expert validators. The purpose of the research, along with its potential benefits and risks, was clearly explained to all stakeholders. Confidentiality and anonymity were maintained throughout the study, with participants' identities protected in all reports and publications. The research complied with the ethical guidelines outlined by the institution and relevant governing bodies.

### Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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