

Development and validation of an interactive learning notebook in Grade 7

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Abstract

Mathematics education is essential for foundational learning, yet engaging Grade 7 students remains a challenge. In the Philippines, learner-centered reforms highlight the need for innovative instructional tools that promote active participation and individualized learning. This study developed and validated an interactive learning notebook for Mathematics 7. Using a descriptive-developmental research design, the study followed a systematic process of planning, designing, and validating the instructional material. Five subject matter experts evaluated its content validity, ensuring alignment with learning competencies and instructional objectives. The notebook was assessed as "very much valid," affirming its accuracy, relevance, and usability. Findings indicate that the interactive learning notebook is a highly valid tool for enhancing student engagement and comprehension of mathematical concepts. The study recommends its integration into classroom instruction to improve learning experiences and academic performance. Additionally, pilot testing in real classroom settings is suggested to assess its impact on student outcomes. Future research may explore the long-term effects of interactive learning materials on mathematical proficiency and overall academic achievement.

Keywords: interactive learning notebook, mathematics education, curriculum-based instruction, instructional material, mathematics

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1. Introduction

Mathematics education persistently grapples with global challenges, often manifesting as negative societal perceptions and pervasive math anxiety, significantly impeding students' comprehension and application of mathematical concepts (Dowker et al., 2016; Carey et al., 2017). These issues are frequently exacerbated by less effective pedagogical approaches, underscoring the urgent need for supportive learning environments and innovative teaching methodologies (Hattie, 2009; Slavin, 2010). The COVID-19 pandemic further intensified these pre-existing challenges, causing substantial disruptions to education systems worldwide and widening learning disparities, particularly in disadvantaged communities with limited access to essential resources and technology (Bansilal et al., 2021). While parental involvement has been identified as a crucial factor in mitigating these adverse effects (Xiong, 2021; Aquino et al., 2019), its impact remains heterogeneous across diverse contexts.

Globally, innovative instructional strategies, including technology-enhanced learning, the integration of real-world contexts, and hands-on activities, have demonstrated considerable potential in enhancing student engagement and transforming their attitudes towards mathematics (Boaler, 2016; National Council of Teachers of Mathematics, 2014). These approaches are particularly salient at foundational levels, such as middle school, where cultivating a positive disposition towards mathematics and fostering critical thinking skills are paramount (Vukovic et al., 2020; Nalagon, 2021).

In the Philippines, the systemic challenges within the educational landscape amplify these global trends. The 2022 Programme for International Student Assessment (PISA) results positioned the Philippines among the lowest-performing countries in mathematics, science, and reading, with Filipino students achieving an average math score of 355, significantly below the OECD average. Alarming, only 24% of students demonstrated basic proficiency in mathematics, highlighting substantial and persistent learning deficits since the 2018 PISA assessment. The pandemic further aggravated these issues, starkly revealing inequities in access to quality education and technological resources (Tria, 2021). Although parental involvement has shown positive correlations with student outcomes, its consistency across different regions remains a concern (Philstar, 2023).

Within the Ilocos Sur context, local research echoes these national patterns of underachievement in mathematics. Common challenges reported include poor retention of mathematical concepts, difficulties in problem-solving, and a limited ability to connect mathematical lessons to real-life situations. For instance, a study involving senior high school students at Candon National High School highlighted their struggles in relating mathematical concepts to practical applications, negatively impacting their academic performance (Garcia & Dela Rosa, 2021). Similarly, data from Ilocos Sur Polytechnic State College (2023) indicates persistent challenges in mathematics proficiency among their incoming students. Efforts to address these issues have emphasized the importance of adopting innovative and student-centered pedagogical approaches; however, the consistent and widespread implementation of such strategies remains a challenge.

Focusing on Grade 7 students in Ilocos Sur, studies have identified significant difficulties in mathematics performance. Research involving 89 students demonstrated that the introduction of contextualized learning materials led to a notable improvement in their assessment scores, underscoring the potential of tailored interventions and localized instructional resources in addressing learning gaps (IJAMS, 2021; Del Castillo, 2010).

In the municipality of Tagudin, Ilocos Sur, the underperformance of Grade 7 students in mathematics is further evidenced by the National Achievement Test (NAT) results, where the Mean Percentage Score (MPS) of 48.63% fell below the national benchmark (Scimatic Journal, 2023). Furthermore, the final MPS for Grade 7

students at Tagudin National High School during the 2022–2023 school year was 52.06%, indicating ongoing difficulties despite the return to face-to-face instruction. Factors contributing to this low performance have been attributed to math anxiety, a lack of student interest in the subject, and the continued reliance on potentially less engaging teaching methods such as direct instruction and TV-radio-based lessons (DEPED PINES, 2016).

The newly introduced MATATAG Curriculum in the Philippines (Kilag et al., 2024) aims to address these systemic challenges by emphasizing humanized learning, reducing content overload, and focusing on essential skills to improve academic outcomes, particularly in mathematics. Its structured design, integrating key mathematical domains and promoting contextualized learning, holds promise for strengthening students' foundational understanding and enhancing their mathematical proficiency. The phased implementation, starting with Grade 7 in the 2024-2025 school year, presents a critical window for research to support its effective adoption.

While the MATATAG Curriculum offers a framework for improving mathematics education, and previous studies in Ilocos Sur have highlighted the potential of localized materials (IJAMS, 2021; Del Castillo, 2010), there is a notable gap in research specifically investigating the design, implementation, and validation of interactive learning notebooks as a tool to support the Grade 7 mathematics curriculum within the unique context of Tagudin, Ilocos Sur. Existing studies in the region have primarily focused on broader interventions or specific content areas without exploring the potential of interactive notebooks to foster active learning, critical thinking, and deeper conceptual understanding aligned with the new curriculum's emphasis on engagement and practical application. Furthermore, there is a lack of empirical evidence on how interactive learning notebooks, tailored to the specific needs and learning environment of Grade 7 students in Tagudin, can address the identified challenges of math anxiety, lack of interest, and the need for more engaging pedagogical approaches.

Addressing these persistent challenges necessitates the development and evaluation of innovative teaching tools that promote active participation, critical thinking, and deeper conceptual understanding. Interactive learning notebooks have emerged as a promising educational tool, integrating traditional note-taking with dynamic activities that actively involve students and enhance their learning experience (Marzano, Pickering, & Pollock, 2001; Himmele & Himmele, 2011). These notebooks provide a structured platform for students to organize information, reflect on mathematical concepts, and apply their knowledge in meaningful ways, making them particularly relevant for mathematics education. Therefore, this study aims to address the identified gap by designing, developing, and validating an interactive learning notebook specifically tailored for Grade 7 mathematics students in Tagudin, Ilocos Sur, within the framework of the newly implemented MATATAG Curriculum. By evaluating its impact on student engagement, conceptual understanding, and ultimately, their mathematical performance, this research seeks to provide valuable insights for educators and curriculum developers in the region and contribute to the broader efforts of improving mathematics education in the Philippines.

Framework of the Study - This study, which focuses on the development and validation of an interactive learning notebook for Grade 7 learners at Tagudin National High School, is primarily underpinned by the principles of **Constructivist Learning Theory**. Constructivism, as articulated by scholars like Jean Piaget (1950) and Lev Vygotsky (1978), posits that learning is an active process in which learners construct new ideas or concepts based on their current knowledge and past experiences. It emphasizes that knowledge is not passively received but is actively built by the learner. Key tenets of constructivism that are relevant to this study include:

Active Learning: Constructivism underscores the importance of learners being actively involved in the learning process. Interactive learning notebooks are designed to promote active participation through activities, problem-solving tasks, and opportunities for reflection.

Social Interaction: Vygotsky's social constructivism highlights the role of social interaction in learning. Interactive notebooks can facilitate collaborative learning, allowing students to share ideas, discuss concepts, and learn from each other.

Meaningful Context: Constructivism emphasizes the importance of learning in meaningful contexts. This study's focus on developing a notebook tailored to the local context of Tagudin, Ilocos Sur, aligns with this principle by making the learning relevant and relatable to the students' lives.

Prior Knowledge: Constructivism recognizes the significance of learners' prior knowledge in the learning process. The design of the interactive notebook should consider students' existing understanding of mathematical concepts and build upon it. Furthermore, the study also draws upon **Self-Determination Theory (SDT)**, proposed by Deci and Ryan (1985), which emphasizes the importance of intrinsic motivation in learning. SDT suggests that learners are more likely to be engaged and successful when their needs for autonomy, competence, and relatedness are met.

Autonomy: Interactive learning notebooks can provide students with a sense of ownership over their learning by allowing them to personalize their notebooks, make choices about how they learn, and track their own progress.

Competence: The notebook can be designed to provide students with opportunities to experience success and develop a sense of competence in mathematics. Clear learning objectives, well-structured activities, and opportunities for feedback can help students build their confidence and skills.

Relatedness: The notebook can also foster a sense of relatedness by promoting collaboration and interaction among students. Group activities, peer feedback, and opportunities to share their work can help students feel connected to their classmates and the learning community.

By grounding the study in these theories, the development and validation of the interactive learning notebook will aim to create a learning tool that actively engages students, promotes meaningful learning, and fosters their motivation and self-efficacy in mathematics. The conceptual framework for this study illustrates the key variables and their relationships in the development and validation of an interactive learning notebook for Grade 7 learners.

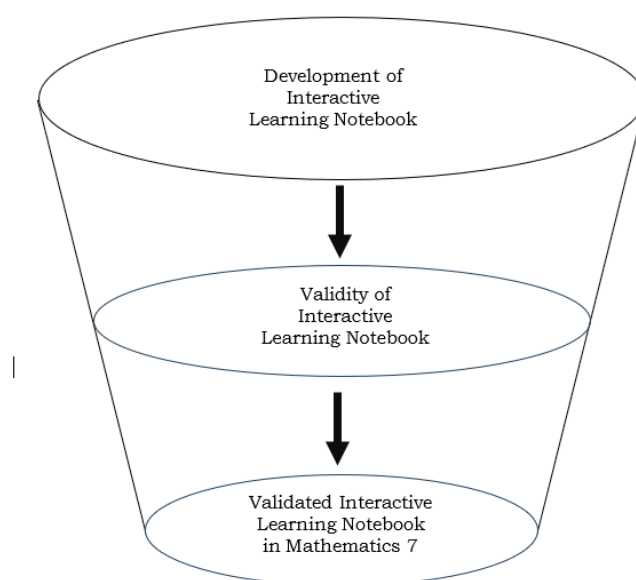


Figure 1. The Research Paradigm

The inputs include the factors that influence the development of the interactive learning notebook like the new curriculum guides the content and learning objectives of the notebook. The specific needs, learning styles,

and prior knowledge of the target learners in Tagudin National High School inform the content and activities included in the notebook. The local context, including the students' cultural background, environment, and real-life experiences, shapes the examples, activities, and applications included in the notebook.

The development and validation process include the process of creating the content, activities, and structure of the notebook, incorporating principles of constructivism and self-determination theory, and aligning it with the MATATAG Curriculum. The validation of the Interactive Learning Notebook involves evaluating the notebook's validity (content, face, and construct) and reliability through expert review and pilot testing with Grade 7 students.

Lastly, the validation of the interactive learning as output of the study. The validated Interactive Learning Notebook is a learning tool that is deemed valid and reliable for Grade 7 mathematics instruction. It is expected that the output increases student engagement in mathematics learning. The use of the interactive notebook is expected to lead to improved student understanding of mathematical concepts and skills.

The framework illustrates that the development of the interactive learning notebook is guided by theoretical principles, curriculum requirements, and the specific needs of the learners. The validation process ensures the quality of the notebook, and the expected outcomes include a validated learning tool and improved student learning.

Objectives of the Study - This study aimed to develop and validate an interactive learning notebook specifically designed for Grade 7 mathematics instruction. Specifically, it sought to answer the following research questions: 1. What is the level of content validity of the interactive learning notebook; and 2. What is the level of face validity of the interactive learning notebook?

2. Methodology

Research Design - This study employs a **developmental research design**. This design is appropriate because the primary aim is to develop and validate an educational tool—specifically, an interactive learning notebook for Grade 7 mathematics. According to Richey and Klein (2007), developmental research focuses on analyzing learning needs; designing and developing instructional materials; and evaluating the effectiveness of these materials. In this context, the research involved a systematic process of analyzing the needs of Grade 7 mathematics learners in Tagudin National High School, considering the MATATAG Curriculum and the challenges they face; creating the interactive learning notebook, incorporating principles of constructivism and self-determination theory; and evaluating the content and face validity of the developed notebook through expert review.

Population and Locale of the Study - The study was conducted at Tagudin, Ilocos Sur, Philippines. Five expert validators from the Department of Education were involved in the study.

Research Instrument - The primary research instrument for validating the interactive learning notebook is an expert review questionnaire. This questionnaire was used to evaluate the content and face validity of the learning material. The questionnaire was adapted from established validation practices, drawing upon principles outlined in sources such as Evans & Martin (2019) and other relevant literature on instructional material validation. The expert review process involved mathematics educators and curriculum specialists assessed the interactive learning notebook based on criteria such as content and face validity. Experts provided their ratings using a Likert scale. To quantify the level of agreement among experts, a Content Validity Index (CVI) was calculated. The CVI provided a numerical representation of the degree to which the interactive learning notebook is judged to be content valid.

Analysis of Data - To analyze the data, the mean scores for each item on the questionnaire were calculated. This provided a measure of the average rating given by the experts for each aspect of content and face validity.

The mean scores were then compared to established criteria or benchmarks to determine the overall level of validity. For example, a predetermined threshold (e.g., a mean score of 3.5 on a 4-point scale) may be used to indicate acceptable validity. In addition to the mean scores, the Content Validity Index (CVI) was calculated to provide a more robust measure of inter-rater agreement.

Ethical Considerations - This study adhered to strict ethical guidelines, prioritizing the protection and respect of all participants. Prior to data collection, letters detailing the study's purpose, procedures, potential risks, and benefits were sent to identified schools, seeking their cooperation and informing them of the voluntary nature of teacher participation. The validators were explicitly informed that their participation was entirely voluntary and that they were free to withdraw at any point without consequence, ensuring no coercion was involved. Informed consent was obtained, emphasizing confidentiality and anonymity in data handling, with data securely stored and access restricted to the researcher. The study design minimized potential harm, and participants were treated with respect, ensuring their rights to privacy and autonomy were upheld.

3. Results and discussion

3.1 Content Validity of the Interactive Learning Notebook

Table 1 presents the level of content validity of the interactive learning notebook as assessed by five experts in the field of mathematics and instructional materials development in the Department of Education.

Table 1
Level of Content Validity of the Interactive Learning Notebook

INDICATORS	MEAN	DER
The contents correspond with activities.	4.80	Very Highly Valid
Learning activities satisfy the stated objectives.	5.00	Very Highly Valid
The content was based on the First Semester MELC of Grade 7 Mathematics MATATAG Curriculum.	5.00	Very Highly Valid
The content provides immediate learning needs.	4.60	Very Highly Valid
The content is arranged in the correct sequence	4.80	Very Highly Valid
The interactive learning notebook provides varied activities to sustain interest.	4.40	Very Highly Valid
The interactive learning notebook contains relevant activities	4.80	Very Highly Valid
The activities provide practical work.	4.40	Very Highly Valid
The activities conform with the concepts.	4.80	Very Highly Valid
The interactive learning notebook covers all essential topics and concepts.	5.00	Very Highly Valid
Overall Mean	4.76	Very Highly Valid

In this table, the mean scores for each indicator range from 4.4 to 5.00, with an overall mean of 4.76. All indicators are rated as "Very Highly Valid." This suggests that, according to the expert reviewers, the interactive learning notebook demonstrates a high degree of content validity. The content aligns well with the activities, satisfies the learning objectives, is based on the curriculum, meets learning needs, is logically sequenced, provides varied and relevant activities, offers practical work, conforms with the concepts, and covers all essential topics.

The high validity ratings suggest that the interactive learning notebook aligns well with the MATATAG Curriculum. This implies that the notebook can be a valuable tool for teachers in effectively implementing the curriculum's goals and objectives. In addition, the notebook's design, which incorporates varied and relevant activities, practical work, and a logical sequence, is likely to enhance students' learning experiences. The focus on active learning and engagement can lead to deeper understanding and retention of mathematical concepts. Moreover, the notebook's ability to address immediate learning needs suggests that it can be a valuable resource for diverse learners. The activities and content can be adapted to meet the specific needs of students with different learning styles and abilities. The notebook can serve as a model for effective teaching practices, demonstrating how to design and implement engaging and standards-aligned mathematics instruction.

The consistently high validity ratings carry significant implications for classroom practice. This interactive

learning notebook stands out as a potentially invaluable tool for teachers implementing the MATATAG Curriculum. Its alignment with learning objectives and curriculum content can save teachers valuable time in resource creation and ensure that their instruction is in sync with educational standards. Furthermore, the notebook's emphasis on engaging activities and practical work can serve as a model for effective teaching methodologies, encouraging a more student-centered and interactive learning environment.

Moreover, the design principles embedded within the notebook, as validated by the experts, point towards a resource that can significantly enhance students' learning experiences. The combination of relevant content, varied activities, practical application, and logical sequencing is likely to foster deeper understanding, improve engagement, and promote better retention of mathematical concepts. The "interactive" nature of the notebook, though not explicitly detailed in the table, likely contributes to this positive outlook by encouraging active participation and self-directed learning.

3.2 Level of Face Validity of the Interactive Learning Notebook

Table 2 shows the level of content validity of the interactive learning notebook.

Table 2
Level of Face Validity of the Interactive Learning Notebook.

INDICATORS	MEAN	DER
The graphic organizers are evident.	4.80	Very Highly Valid
The format presented is logical.	4.80	Very Highly Valid
The format is easy to understand.	4.60	Very Highly Valid
The format helps facilitate lesson presentation.	4.80	Very Highly Valid
The interactive learning notebook is visually appealing in layout and design.	4.40	Very Highly Valid
The format has clear section headings and subheadings	5.00	Very Highly Valid
The format consistent font styles and sizes	4.60	Very Highly Valid
The pages have balanced use of white space	4.60	Very Highly Valid
The pages have proper alignment of text and visuals	4.80	Very Highly Valid
The note-taking pages have Interactive SmartArt Graphics for engaging notetaking	4.60	Very Highly Valid
Overall Mean	4.70	Very Highly Valid

The mean scores for each indicator range from 4.40 to 5.00, with an overall mean of 4.70. All indicators are rated as "Very Highly Valid." This suggests that, according to the expert reviewers, the interactive learning notebook demonstrates a high degree of face validity. The format and design of the notebook are logical, easy to understand, visually appealing, and facilitate lesson presentation. The notebook also makes effective use of graphic organizers, clear section headings, consistent font styles, balanced white space, proper alignment of text and visuals, and engaging note-taking strategies.

The results presented in Table 2, demonstrate the high face validity of the interactive learning notebook, have significant implications for its practical use and effectiveness in the classroom. The consistently high ratings across all indicators suggest that the notebook's design and presentation are likely to be well-received by both teachers and students. This positive evaluation of the notebook's format, visual appeal, and organization indicates that it is not only pedagogically sound but also user-friendly, which can contribute to its successful implementation and integration into daily classroom activities.

Specifically, the strong face validity of the interactive learning notebook implies that it is likely to enhance student engagement and facilitate the learning process. The logical format, clear section headings, and effective use of visual elements such as graphic organizers and SmartArt graphics can help students to better organize and understand the material. Additionally, the visually appealing layout and design can capture students' attention and increase their motivation to use the notebook. For teachers, the notebook's user-friendly design can simplify lesson planning and delivery, making it easier to incorporate active learning strategies and differentiate instruction.

4. Implication to policy and practice

The findings of this study have several implications for educational policy and practice, particularly in the context of curriculum implementation and instructional design:

Curriculum Alignment: The study underscores the importance of aligning instructional materials with the curriculum. Policymakers and educational leaders should ensure that teachers have access to high-quality, standards-aligned resources that support effective teaching and learning.

Teacher Professional Development: The study highlights the need for ongoing professional development for teachers. To effectively use innovative instructional materials like interactive learning notebooks, teachers need training and support to integrate them into their practice.

Resource Allocation: Educational institutions should invest in the development and provision of high-quality instructional materials. This includes funding for the design, development, and validation of resources that meet the needs of both teachers and students.

Focus on Active Learning: The study supports the shift towards active learning approaches. Policymakers and educators should promote the use of instructional strategies that engage students in the learning process and encourage them to construct their own understanding.

Contextualization of Instruction: The study emphasizes the importance of contextualizing instruction to make it relevant to students' lives. Curriculum developers and teachers should consider the local context, culture, and experiences of students when designing and implementing instructional materials. Dela Cruz (2019) emphasized that effective strategies in teaching with meaningful intervention activities to develop positive attitudes and beliefs of the students are recommended.

Learners. The study signals a move towards more engaging mathematics learning through a validated interactive notebook. This tool, designed with varied activities and clear organization, aims to enhance understanding and active participation in Grade 7 math. Ultimately, the notebook's focus on practical application and visual aids can make learning more accessible and improve students' overall academic experience.

Teachers. This study offers a validated interactive learning notebook as a readily available and effective tool aligned with the MATATAG Curriculum for Grade 7 mathematics. The expert validation confirms its content accuracy, relevance, and user-friendliness, potentially saving teachers time in resource creation and providing a structured approach to enhance student engagement and comprehension. Integrating this notebook into their instruction can support the implementation of active learning strategies and provide a model for developing engaging, standards-aligned mathematics lessons.

5. Conclusion

This study concludes that the interactive learning notebook, as developed and validated, meets the standards for both content and face validity. It is therefore recommended that the interactive learning notebook be implemented in Grade 7 mathematics classrooms at Tagudin National High School. Teachers be provided with professional development and support to effectively integrate the notebook into their instructional practices. Further research be conducted to evaluate the impact of the interactive learning notebook on student achievement, engagement, and motivation.

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