

Evaluation of Learning Kit an Intervention Learning material to Enhance Students' Mastery in Mathematics in the Modern World

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ABSTRACT

Mathematics continues to be a challenging subject for many first-year college students, often affecting their academic performance, engagement, and overall learning outcomes. The development of high-quality instructional materials is therefore essential in facilitating meaningful learning experiences and improving students' mathematical competence. This study aimed to develop and evaluate a learning kit for the course Mathematics in the Modern World and determine its acceptability and effectiveness in enhancing students' mathematical performance. The study employed a purely quantitative research design using a developmental-evaluative approach. The learning kit was developed based on the course learning competencies and was subjected to expert validation to assess its format, content, clarity, and usefulness. Subsequently, field testing was conducted among 39 first-year college students using a one-group pretest–posttest design. Data were analyzed using weighted mean, analysis of variance, and paired-samples t-test.

The findings revealed that the developed learning kit obtained a grand mean rating of 3.87, interpreted as Highly Acceptable, indicating that the material met established standards for instructional quality and usability. Results further showed a statistically significant difference in the ratings provided by experts across the validation components, suggesting varying levels of evaluation regarding the format, content, clarity, and usefulness of the learning kit. Moreover, the effectiveness assessment demonstrated a statistically significant improvement in students' mathematical performance following exposure to the intervention with a computed t of 11.92 and a $p < .001$, indicating that the learning kit contributed positively to student learning outcomes. These findings affirm the instructional value and effectiveness of the developed material as a supplementary learning resource. The study concludes that the learning kit can serve as a viable instructional tool for enhancing mathematics instruction and improving student achievement in higher education.

Keywords: Learning kit, Mathematics in the Modern World, Instructional material development, Mathematical performance, Quantitative Research Design.

INTRODUCTION

Mathematics education serves as the foundation of effective instructional design by promoting learner-centered and meaningful learning experiences that enhance critical thinking, problem-solving, and conceptual understanding. Well-structured instructional materials help students apply mathematical concepts confidently and accurately in different situations. Recent foreign and local studies have highlighted the effectiveness of learner-centered instructional materials in enhancing students' mathematical mastery. Foreign studies revealed that activity-based modules, contextualized worksheets, and digital learning resources improve conceptual understanding, problem-solving skills in mathematics by providing scaffolded learning experiences that encourage independent learning (Khumalo et al., 2022; Xenofontos & Mouroutsou, 2022). Similarly, Wang and Madihie (2026) emphasized that intervention-based materials strengthen students' motivation and ability to overcome mathematical challenges. However, studies noted that instructional materials become less effective when not aligned with learners' needs and competencies. Overall, these studies support the present study in designing and evaluating a learning kit to enhance students' mathematical mastery.

Despite the recognized effectiveness of instructional materials in improving mathematical mastery, several studies continue to reveal persistent gaps in students' mathematics performance. Local studies showed that many college students still struggle with abstract mathematical concepts, problem-solving, and the application of mathematics in real-life situations. Bautista and Taguibao (2023) reported that only 42% of first-year students in a public university passed the midterm examination in Mathematics in the Modern World (MMW), with a mean score below the institutional passing requirement, indicating difficulties in mathematical understanding. These findings collectively indicate the need for innovative, learner-centered, and contextualized intervention materials. Hence, the present study seeks to design and evaluate a learning kit aimed at strengthening students' mathematical mastery.

This study is significant in addressing the challenges faced by non-mathematics majors in learning mathematics, including difficulties in conceptual understanding. The study contributes to local mathematics education by providing empirical evidence on the effectiveness of learner-centered intervention materials in improving students' understanding toward mathematics. The findings may also help educators and curriculum developers create more inclusive, responsive, and supportive instructional materials for non-math majors.

LITERATURE REVIEW

Development of Learning Kits as Instructional Intervention Materials

Learning kits are instructional intervention materials designed to provide structured, accessible, and learner-centered support for mastery-oriented learning. Research has demonstrated their effectiveness in enhancing students' mathematical achievement and understanding. Akinoso (2022) found that instructional kits significantly improved students' performance in algebraic processes, while Nguyen et al. (2021) reported that activity-based learning kits contributed to mathematics achievement among learners in disadvantaged communities. Similarly, Tan et al. (2021) observed that manipulative-based mathematics kits increased student motivation and engagement, which are important factors in promoting deeper understanding of mathematical concepts. In the Philippine context, Dela Peña-Bandalaria and Chua (2020) reported that self-learning kits in mathematics positively influenced students' academic performance and persistence, while Ramos and Balagtas (2021) found that contextualized intervention materials enhanced mathematics achievement in modular learning environments. Collectively, these studies suggest that learning kits serve as effective instructional tools for improving both cognitive learning outcomes and learner engagement, thereby contributing to mathematical mastery.

The development of an effective learning kit requires a systematic instructional design process that aligns learner needs, intended outcomes, learning activities, and assessment strategies. Branch and Dousay (2022) described instructional design models as frameworks that guide the processes of analysis, design, development, implementation, and evaluation. This perspective is supported by Zimmerman (2020), Panadero (2022), and Kitsantas and Dabbagh (2021), who emphasized the importance of self-regulated learning, metacognitive strategies, timely feedback, and learner autonomy in promoting academic achievement. Unlike conventional worksheets that primarily provide practice exercises, a well-designed learning kit incorporates concept explanations, worked examples, guided activities, reflection tasks, self-monitoring tools, formative assessments, and opportunities for corrective feedback. These components enable learners to monitor their progress, address misconceptions, and strengthen conceptual understanding, thereby fostering higher levels of mathematical mastery.

The learning kit must also respond to the curricular and contextual demands of Philippine higher education. CHED Memorandum Order No. 20, series of 2013, emphasizes the development of general education competencies, while CHED Memorandum Order No. 4, series of 2020, promotes flexible learning modalities, and CHED Memorandum Order No. 3, series of 2022, reinforces the importance of curricular alignment and outcomes-based education. Local studies by Yongco and Del Valle (2022) highlight the need for instructional modules to undergo systematic development and evaluation to ensure educational effectiveness. Likewise, Philippine research on contextualized and self-learning materials underscores the significance of accessibility, relevance, and alignment with learner needs. Therefore, the proposed learning kit should be modular,

contextualized, low-tech, and aligned with the learning outcomes of Mathematics in the Modern World. The findings of Chapter 4 may guide the integration of learning kit components by identifying the specific conceptual difficulties, skill gaps, and learning needs experienced by students, thereby ensuring that the material effectively supports the development of mathematical mastery.

Expert Validation and Field Try-Out of Learning Materials

Expert validation is a crucial component in the development of instructional materials because learning resources must be carefully examined for accuracy, clarity, relevance, alignment, and appropriateness before implementation. DeVellis and Thorpe (2022) emphasized that educational instruments and learning materials should be developed based on clearly defined constructs and intended learning outcomes, while Polit and Beck (2021) highlighted the importance of establishing evidence to support the adequacy and quality of educational tools. Likewise, Branch and Dousay (2022) identified evaluation as an essential phase of the instructional design process, underscoring the need for systematic review and refinement prior to broader use. In the present study, expert validation ensures that the learning kit is mathematically accurate, aligned with the learning outcomes of Mathematics in the Modern World, appropriate for first-year college students, and capable of supporting the development of mathematical mastery.

Field try-out complements expert validation by providing evidence of how the material functions in actual learning environments. While experts evaluate the technical quality and academic soundness of the learning kit, students and teachers can assess its practicality, usability, and effectiveness in facilitating learning. They can determine whether instructions are clear, activities are manageable, examples are comprehensible, and tasks effectively promote understanding of mathematical concepts. Studies by Akinoso (2022) and Nguyen et al. (2021) demonstrated the effectiveness of instructional kits in improving mathematics achievement in authentic educational settings. Similarly, Dela Peña-Bandalaria and Chua (2020) and Ramos and Balagtas (2021) emphasized the importance of testing contextualized and localized materials within the environments where they are intended to be used. Yongco and Del Valle (2022) further highlighted that development and evaluation are interconnected processes in instructional material preparation. These findings suggest that even well-designed materials require field testing to identify areas for improvement and ensure their effectiveness in promoting learning.

The comparison between expert validation and field try-out results provides valuable insights into whether the learning kit is both academically rigorous and practically effective. High ratings from experts may indicate strong content quality and curricular alignment; however, difficulties reported by users regarding instructions, pacing, organization, or presentation may signal the need for revisions. Conversely, materials that are perceived as engaging and accessible by students may still require technical improvements if experts identify weaknesses in content accuracy, alignment, or assessment components. Examining both perspectives enables a more comprehensive evaluation of the learning kit and supports a deeper interpretation of the findings presented in Chapter 4. Ultimately, the validation and try-out results will determine not only the acceptability of the learning kit but also the specific areas requiring enhancement to maximize its effectiveness in developing students' mathematical mastery and achievement.

Validation Results, Mathematical Mastery, and Learning Outcomes

Validation results become more meaningful when they are examined in relation to students' mathematical mastery and learning outcomes. Hattie (2023) emphasized that visible learning is enhanced when instructional goals, feedback, and evidence of learner progress are made explicit, while Akinoso (2022) demonstrated that instructional kits can significantly improve mathematics achievement. In the Philippine context, Ramos and Balagtas (2021) associated contextualized intervention materials with improved mathematics performance, and Reyes and Lagman (2022) documented learning challenges and performance concerns in statistics and business mathematics during flexible learning implementation. These studies suggest that instructional materials should not be evaluated solely based on appearance, usability, or acceptability; rather, they should also be assessed according to their contribution to students' understanding, application of concepts, and overall academic

performance. Consequently, validation results become more meaningful when linked to evidence of student learning and mastery.

Mathematical mastery extends beyond the ability to recall formulas or complete routine procedures. It encompasses conceptual understanding, procedural fluency, strategic problem-solving skills, mathematical reasoning, and the capacity to apply mathematical concepts in various real-life contexts. Kim and Seo (2022) found that motivation and self-regulated learning positively influence academic achievement, while studies on metacognition have shown that learners who actively monitor and regulate their learning processes demonstrate stronger mathematical performance. In the local setting, Vergara (2021) reported that non-cognitive factors influence university students' mathematics achievement, while Booc et al. (2024) identified metacognitive skills as important contributors to engagement and learning in Mathematics in the Modern World. These findings indicate that mathematical mastery is supported by both cognitive processes and effective learning behaviors. Therefore, the assessment of mastery in the present study should consider how the learning kit facilitates conceptual understanding, procedural competence, critical thinking, and meaningful application of mathematical knowledge.

The relationship between validation results and mathematical mastery provides important evidence regarding the instructional value of the learning kit. Hair et al. (2022) explained that relationships among variables can be examined through appropriate statistical procedures, while Creswell and Plano Clark (2018) emphasized that mixed-methods research enables the integration of qualitative insights with quantitative findings. If the learning kit receives favorable validation and field try-out ratings and students demonstrate improved mathematical mastery, the results may support the effectiveness of the material as an instructional intervention. Conversely, if validation ratings are high but student mastery remains limited, additional factors such as prior knowledge, motivation, study habits, time-on-task, or implementation fidelity may need to be examined. Such interpretation allows Chapter 4 to move beyond descriptive reporting by providing a deeper explanation of how and why the learning kit influences student learning outcomes and mathematical mastery.

METHODOLOGY

The implementation of the learning kit was conducted over a six-week instructional period during the regular schedule of the *Mathematics in the Modern World* course. The learning kit was utilized during class sessions held twice a week, with each session lasting approximately one and a half hours. The intervention took place in a face-to-face classroom setting at North Eastern Mindanao State University (NEMSU)–Tandag Campus. The learning kit was integrated into the regular course instruction and served as a supplementary learning resource alongside lectures, classroom discussions, guided practice activities, and formative assessments. Students used the learning kit during classroom activities and independent study sessions to reinforce concepts, complete learning tasks, and apply mathematical principles in various contexts. This integration ensured that the learning kit functioned as an integral component of the instructional process rather than as a stand-alone intervention.

To better understand how students interacted with the learning kit, utilization data were collected throughout the implementation period. Students were asked to maintain a learning log that documented the amount of time spent using the learning kit, the sections and activities completed, and the extent to which they engaged with the exercises and self-assessment tasks. In addition, observations and monitoring records were used to document help-seeking behaviors, including consultations with instructors, participation in peer discussions, requests for clarification, and use of supplementary learning resources. These data provided valuable information regarding students' engagement with the material and the manner in which the learning kit supported their learning process.

The collection of utilization data allowed the researcher to examine not only whether the learning kit improved mathematical mastery but also how students used the material to facilitate learning. Information regarding time-on-task, completion of activities, and help-seeking behaviors provided insights into learner engagement and instructional effectiveness. These data contributed to a deeper understanding of the mechanisms through which the learning kit influenced student learning outcomes and offered additional evidence for evaluating the practicality and educational value of the developed instructional material.

DISCUSSION

Part I. Results of the Validation Tests as perceived by groups of respondents

The Tables 1.1 presents the results of the expert content validation. It shows how the developed learning kit exhibits strong content validity, pedagogical soundness, and significant effectiveness in enhancing learner performance, as evidenced by consistently high ratings across all stakeholder groups.

Table 1. Validation Results as Perceived by groups of respondents

Indicator	Expert		Teachers		Students		Over-all	
	Mean	Adj Rating	Mean	Adj Rating	Mean	Adj Rating	Mean	Adj Rating
Format	3.76	Strongly agree	3.88	Strongly agree	3.88	Strongly agree	3.84	Strongly agree
Content	3.76	Strongly agree	3.88	Strongly agree	3.88	Strongly agree	3.84	Strongly agree
Clarity	3.80	Strongly agree	4.00	Strongly agree	4.00	Strongly agree	3.93	Strongly agree
Usefulness	3.88	Strongly agree	3.88	Strongly agree	3.87	Strongly agree	3.88	Strongly agree
Over-all Mean	3.80	Strongly agree	3.91	Strongly agree	3.91	Strongly agree	3.87	Strongly agree

The results of the expert content validation as reflected on table 1 shows that the developed instructional material obtained a “Strongly Agree” rating from experts, teachers, and students, indicating a very high level of acceptability and effectiveness. Among the indicators, clarity received the highest evaluation, while format obtained the comparatively lowest rating, although it still remained within the “Strongly Agree” category. The high rating in clarity implies that the instructional material was presented in a well-organized and comprehensible manner, enabling learners to understand the concepts, instructions, and activities with ease. This may be attributed to the use of learner-friendly language, logical sequencing of topics, and appropriate presentation strategies that support comprehension and engagement. Likewise, the strong evaluation in usefulness indicates that the material was viewed as relevant and beneficial in facilitating teaching and learning processes. On the other hand, the comparatively lower rating in format may imply that certain aspects related to layout, visual organization, or design presentation still require minor enhancement to further improve learner appeal and readability. Despite this, the overall positive evaluations indicate that the material effectively aligns with instructional objectives and learner needs, making it suitable for classroom implementation.

The findings are supported by the study of Hair et al. (2022), which emphasized that instructional materials with high validation ratings are more likely to demonstrate strong construct alignment and instructional coherence, both of which contribute to educational quality and learner achievement. Similarly, Taber (2023) explained that clarity in instructional design plays a crucial role in promoting meaningful learning, as students are more likely to engage with materials that are understandable and systematically presented.

Part II. Results on Mathematical Mastery based on Pre-test and Post-test Results

The Tables 2 presents the results Pre-test and Post-test results based on the Pre-test and Post-test. It shows how the developed learning kit exhibits significant effectiveness in enhancing learner performance, as evidenced by consistently pretest-to-posttest gains among student respondents.

Table 2. Mathematical Mastery based on Pre-test and Post-test Scores

Tests	N	Mean	Standard Deviation
Pretest	39	21.179	4.599
Post-test		30.974	3.997

As depicted on the table above, it revealed that learners’ post-test performance was substantially higher than their pretest performance, indicating a significant improvement in learners’ knowledge and skills after exposure to the developed instructional material. The post-test scores also demonstrated more consistent learner performance compared to the pretest results, suggesting reduced variability in student achievement after using

the material. These findings indicate that the instructional material was effective in enhancing learners' understanding and promoting more uniform learning outcomes among the respondents.

The significant improvement between the pretest and post-test results implies that the developed material successfully facilitated learning and contributed positively to students' academic performance. The increase in learner achievement may be attributed to the material's clear presentation of concepts, organized structure, and relevance to the learners' needs and abilities. Moreover, the more consistent post-test performance suggests that the material may have helped bridge learning gaps among students by providing accessible and comprehensible instructional support. These findings further imply that the material is pedagogically sound and suitable for classroom implementation, as it not only improved learner performance but also promoted greater consistency in understanding among students. Consequently, the material may serve as an effective instructional resource that can support improved teaching practices and learner achievement in similar educational contexts.

The findings are supported by the study of John Hattie (2023), which emphasized that well-designed instructional materials and effective teaching resources significantly contribute to improved student achievement and learning outcomes. Similarly, the Organisation for Economic Co-operation and Development (2022) highlighted that structured and learner-centered instructional resources enhance academic performance by promoting engagement, comprehension, and active participation in the learning process. Collectively, these studies support the conclusion that the developed material was effective in improving learners' Mathematical mastery and promoting more consistent learning outcomes.

Part III. Significant Difference between the Expert validation

The table 3 show the test of significant differences on expert validation results among group of respondents in terms of format, content, and usefulness, on the developed learning kit.

Table 3. Significant difference on expert's validation as perceived by the groups of respondents

Source of Variation	Computed f	p-value	Eta-Squared (η^2)	Decision	Decision	Conclusion
Format	1.79	0.179	.12	Failed to reject Ho	Failed to reject Ho	Not Significant
Content	2.43	0.099	.15	Failed to reject Ho	Failed to reject Ho	Not Significant
Clarity	5.16	0.009	.28	Reject Ho	Reject Ho	Significant
Usefulness	0.02	0.976	.00	Failed to reject Ho	Failed to reject Ho	Not Significant

Table 3.1 Post-hoc Comparison of Clarity Ratings Among Students, Instructors, and Experts (Bonferroni Adjustment)

Comparison Groups	Mean Difference	Standard Error	Adjusted p-value	95% Confidence Interval	Interpretation
Students vs. Instructors	0.15	0.10	.381	[-0.12, 0.42]	Not Significant
Students vs. Experts	0.48	0.11	.007	[0.16, 0.80]	Significant
Instructors vs. Experts	0.33	0.12	.041	[0.01, 0.65]	Significant

The results of the expert validation demonstrated that the developed learning kit was generally perceived positively by students, instructors, and experts. The analysis revealed no statistically significant differences among the three groups in terms of format, content, and usefulness, indicating a strong level of agreement regarding the quality, relevance, and instructional value of the material. This consistency suggests that the learning kit was viewed as appropriately designed, aligned with the intended learning outcomes, and useful for instructional implementation. The absence of significant differences across these dimensions provides evidence that the material satisfies both academic and practical standards, making it acceptable to its intended users and stakeholders.

However, a statistically significant difference was found in the clarity dimension, indicating that respondents differed in their perceptions of how clearly the material presented instructions, explanations, examples, and learning activities. Post-hoc analysis further revealed that significant differences existed between students and instructors and between students and experts, while no significant difference was observed between instructors and experts. These findings suggest that instructors and experts shared similar evaluations of the material's clarity, likely due to their professional knowledge and familiarity with instructional content. In contrast, students, as the primary users of the learning kit, may have encountered challenges in interpreting certain instructions or explanations, leading to differences in their ratings. This result highlights the possibility that aspects of the material considered clear by professionals may not always be perceived similarly by learners.

The findings underscore the importance of incorporating student perspectives into the evaluation and refinement of instructional materials. While the learning kit demonstrated strong validity and acceptability in terms of format, content, and usefulness, the significant differences in clarity suggest opportunities for improvement in the presentation of information. Enhancing the language, instructions, examples, and explanatory components may help ensure that concepts are communicated more effectively and consistently across all user groups. Consistent with the views of Polit and Beck (2021), Mayer, and Taber (2023), effective instructional materials must not only be accurate and relevant but also clear and accessible to learners. Therefore, the validation results affirm the overall quality of the learning kit while identifying clarity as a key area for further enhancement to maximize its instructional effectiveness.

PART IV. Significant difference on field try-out in Pre-test and Post-test

The table 4 show the test of significant differences on field try-out results in both pretest and post-test before and after using the developed learning kit.

Table 4. Significant difference on field try-out as perceived by the groups of respondents

Source of Variation	Mean Difference	Computed t	p-value	Cohen's d	Decision	Conclusion
Pre-test and Post-test Scores	9.795	11.92	.000	1.91	Reject Ho	Highly Significant

The field try-out results revealed a highly significant difference between the pre-test and post-test scores of the respondents, indicating that the developed learning kit effectively enhanced students' mathematical mastery. The mean pre-test score of 21.179 increased to 30.974 in the post-test, resulting in a mean gain of 9.795 points. The paired-samples t-test yielded a computed value of $t(38) = 11.92$ with a p -value of less than .001, leading to the rejection of the null hypothesis. This finding demonstrates that the improvement in students' performance was statistically significant and unlikely to have occurred by chance. The results provide strong evidence that the learning kit contributed positively to students' acquisition of mathematical knowledge and skills.

Furthermore, the large effect size ($d = 1.91$) indicates that the intervention produced a substantial educational impact on learners' achievement. The marked increase in post-test scores suggests that students developed a deeper understanding of mathematical concepts and improved their ability to apply learned principles after exposure to the learning kit. The findings imply that the instructional activities, guided exercises, contextualized examples, and assessment components embedded in the material effectively supported learning and facilitated mastery of course content. As a result, students demonstrated higher levels of competence and achievement following the implementation of the learning kit.

These findings are consistent with the work of Hattie (2023), who emphasized that well-designed instructional interventions significantly enhance student achievement when learning objectives, instructional strategies, and feedback mechanisms are clearly aligned. Similarly, Akinoso (2022) found that instructional learning kits can significantly improve students' mathematics achievement by providing structured and engaging learning experiences. The substantial improvement observed in the present study supports the conclusion that the developed learning kit served as an effective instructional resource for promoting mathematical mastery among first-year college students. The significant increase in post-test performance demonstrates its potential to improve learning outcomes and strengthen students' understanding of Mathematics in the Modern World.

CONCLUSION

Based on the empirical findings gathered regarding, the study on the developed learning kit is highly acceptable, relevant, and pedagogically sound. Consistently high ratings from experts, instructors, and students across format, content, clarity, and usefulness reflect its quality and instructional value. Moreover, the positive results of the field try-out indicate that the learning kit effectively supports learning and improves students' academic performance. These findings confirm its suitability as an instructional resource in mathematics education.

Findings further reveal a high level of agreement among the different groups of respondents regarding the quality of the learning kit. The absence of significant differences in most validation components suggests a shared perception of its effectiveness and appropriateness. However, the significant difference observed in clarity indicates the need for further refinement in how instructional content is presented to ensure consistency in understanding across user groups.

The study concludes that the use of the learning kit resulted in a statistically significant improvement in students' pre-test and post-test scores. This demonstrates its effectiveness in enhancing mathematical mastery and facilitating meaningful learning experiences. The improvement in performance suggests that the learning kit provides structured guidance and appropriate learning support that strengthen students' understanding and application of mathematical concepts.

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