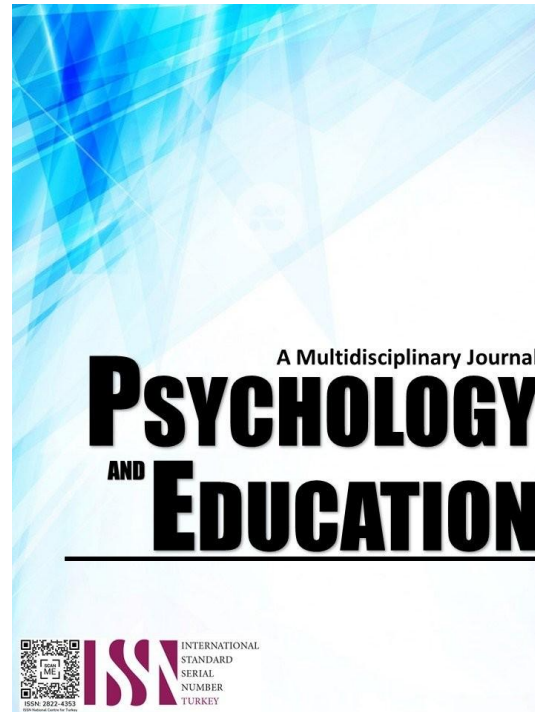


FROM 'HUH?' TO 'AHA!': DEVELOPMENT AND VALIDATION OF A BILINGUAL WORKBOOK IN GRADE 7 MATHEMATICS



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From ‘HUH?’ To ‘AHA!’: Development and Validation of a Bilingual Workbook in Grade 7 Mathematics

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Abstract

Mathematics is often viewed as a difficult subject, particularly for students who struggle with language instruction. The lack of accessible and linguistically appropriate materials contributes to misconceptions and low performance. This study developed and validated a bilingual workbook for Grade 7 students to address language-related barriers and enhance understanding of mathematical concepts. Anchored on Cummins' Theory of Bilingualism and Vygotsky's Sociocultural Theory, the study adopted a descriptive-developmental research design following the ADDIE model of the Research and Development (R&D) approach. A diagnostic test administered to fifty (50) students identified the least-learned competencies in Numbers and Algebra, which guided the workbook content. Moreover, the workbook was validated by five (5) experts (three Mathematics and two language teachers with master's degrees), and evaluated the usability through five pre-service teachers' thoughts. Findings revealed low mastery in competencies such as “describe the set of integers” (MPS = 28.4%), “identify the absolute value of an integer, and its meaning on the number line” (MPS = 31.6%), and “simplify numerical expressions involving integers using number properties and the order of operations” (GEMDAS) (MPS = 32.8%). The workbook received very high validity ratings in terms of content validity (OM = 4.77) and was very highly acceptable in terms of acceptability (OM = 4.74). Content validity analysis showed all 22 items were rated as valid by all experts, yielding a CVR of 1.00 for each item and an overall CVI of 1.00, indicating excellent content validity. Results from pre-service teachers' thoughts also indicated very high ratings across all criteria for the workbook's usability (WM = 4.60). Results affirmed that the bilingual workbook was valid, highly acceptable, and a useful tool for bridging linguistic gaps in Mathematics. The study recommends future experimental research to measure its effectiveness on actual learning outcomes and encourages its application across other subjects and contexts, while also suggesting further refinement, replication, rigor, reach, and relevance to ensure broader educational impact.

Keywords: *bilingual workbook, instructional material, numbers and algebra, instructional materials, language barriers*

Introduction

A widely recognized barrier in mathematics learning is the language of instruction, which not only affects students' ability to solve problems but also limits their overall mathematical understanding and reasoning. In the Philippine context, many learners struggle in mathematics not only because of its abstract concepts but also due to difficulties in comprehending English, which is commonly used in textbooks and learning resources. This language barrier often results in rote memorization rather than conceptual understanding, leading to misconceptions and persistent errors in solving mathematical problems (Visher, 2015; Racca & Lasaten, 2016). International assessments such as the Program for International Student Assessment (PISA) and the National Achievement Test (NAT) further reveal that Filipino students consistently performed below the expected standards in mathematics, due to weak foundations and the challenge of learning through a second language (Lopez, 2023).

To address these challenges, educators have introduced strategies aimed at making mathematics more accessible, including the use of bilingual instructional materials. Bilingual resources present content in both the first language and English, helping learners bridge unfamiliar terminology and improve comprehension. Studies have shown that bilingual instruction supports understanding, enhances academic performance, and builds learner confidence (Cummins, 1984; Moschkovich, 2007). Moreover, studies have shown that instructional materials developed in two languages enhance engagement, relevance, and learner support (TorreFranca, 2017; Rogayan & Dollete, 2019). However, despite these benefits, there is still a lack of validated bilingual instructional materials specifically designed for secondary-level Mathematics in the Philippine context, particularly for Grade 7 learners in the Numbers and Algebra, highlighting a gap in both research and practice.

Given this gap, there is a need for instructional interventions that address both linguistic and conceptual challenges in mathematics learning. Existing English-only materials may not sufficiently support learners with limited language proficiency, thereby hindering their understanding of mathematical concepts. Developing a bilingual workbook that integrates Filipino and English provides a potential scaffolding tool to enhance comprehension and reduce misconceptions. This study is grounded on Cummins' Theory of Bilingualism, which emphasizes the role of first-language proficiency in supporting second-language academic development, and Vygotsky's Sociocultural Theory, which views learning as a socially mediated process enhanced through scaffolding and guided interaction.

This study aimed to develop and validate a bilingual workbook in Grade 7 Mathematics, particularly for the Numbers and Algebra components. It addressed learners' difficulties in the competencies: (1) Describe the set of integers, (2) simplify numerical expressions involving integers using number properties and the order of operations (GEMDAS), and (3) Identify the absolute value of an integer, and its meaning on the number line. The bilingual workbook was developed as an instructional material designed to bridge linguistic gaps and strengthen conceptual understanding through structured bilingual scaffolding. Specifically, it aimed to identify the least-learned competencies of students and evaluate the content validity, acceptability, and usability of the developed workbook based on the thoughts of pre-service teachers. These objectives guided the formulation of the research questions, which focused on determining the quality and usability of the bilingual instructional material.

This study contributes to the fields of Mathematics Education and instructional material development by providing a validated bilingual workbook that addresses language barriers in learning. The findings offer practical implications for teachers, curriculum developers, and instructional designers by highlighting the value of language-sensitive instructional design in improving accessibility and learner engagement. Furthermore, the study supports educational frameworks such as the MATATAG Curriculum and is aligned with Sustainable Development Goal 4 (Quality Education), promoting inclusive and equitable learning opportunities for all learners. Ultimately, this research provides a foundation for future studies and innovations in bilingual and context-responsive mathematics instruction.

Research Questions

This study aimed to develop and validate a bilingual workbook in Mathematics for Grade 7 to address the difficulties of secondary-level students caused by a workbook written entirely in a foreign language. Specifically, it aimed to answer the following questions:

1. What are the least learned competencies of Grade 7 students in Mathematics?
2. What is the content validity of the developed Mathematics Grade 7 Bilingual Workbook in terms of:
 - 2.1. objectives;
 - 2.2. key concepts;
 - 2.3. direction/instructions;
 - 2.4. practical exercises; and
 - 2.5. reflections and topics?
3. What is the level of acceptability of the workbook in terms of:
 - 3.1. clarity;
 - 3.2. usefulness;
 - 3.3. language and style;
 - 3.4. illustrations;
 - 3.5. presentations; and
 - 3.6. suitability?
4. What are the thoughts of pre-service teachers on improving the usability of the developed bilingual workbook?

Literature Review

Bilingual Workbook as Instructional Support in Mathematics

Language barriers in mathematics instruction remain one of the most pressing challenges teachers face in diverse classrooms. Abdulrahim and Orosco (2020) emphasized that many Filipino students who are not exposed to the English language have difficulties in understanding technical mathematical vocabulary and abstract concepts. Paetsch, Felbrich, and Stanat (2015) explained that misinterpretation of mathematical terms often results in misconceptions and low performance in the subject. These linguistic barriers make it difficult for students to connect mathematical discourse with its symbolic representations, thereby hindering comprehension and mastery.

Bilingual education has long been recognized as an effective means of bridging linguistic gaps that hinder learning. Slavkov (2015) observed that when both the first language (L1) and the second language (L2) are used in instruction, comprehension, and learning outcomes improve. Truxaw and Rojas (2014) confirmed that English language learners performed significantly lower in mathematics than their peers, yet proficient bilinguals exhibited stronger mathematical encoding.

Woumans et al. (2016) further asserted that bilingual learners demonstrated enhanced executive functions, outperforming monolinguals in terms of mathematics performance. González-Martín et al. (2024) supported this by showing that proficient bilinguals performed better than monolinguals in mathematical and non-language-related cognitive tasks. Stocco and Prat (2014), together with Becker, Prat, and Stocco (2016), provided neurological evidence that bilinguals processed arithmetic faster and engaged distinct neural mechanisms compared to monolinguals. Hartanto, Yang, and Yang (2018) added that bilingualism exerted a robust positive effect on mathematical achievement across grade levels, even after controlling for demographic and language proficiency variables.

While the advantages of bilingualism are evident, effective instructional tools must be systematically designed. Clark (2015) and Rossett (2006) described the ADDIE model, Analysis, Design, Development, Implementation, and Evaluation, as a comprehensive

framework for developing instructional materials. Widyastuti and Susiana (2019) applied the model in actual mathematics and demonstrated its usefulness in ensuring alignment with students' needs and curriculum standards. Bin Mohd Aris and Mansor (2023) successfully used the ADDIE model as the module development design framework in creating a teaching and learning module for four-year-old learners about plants, while Bayranvand (2009) revealed that students taught through ADDIE-based instruction achieved better outcomes than using traditional methods. Shahbeigi (2010) likewise emphasized that the model improved retention and academic motivation. Collectively, these studies highlight that ADDIE provides a systematic and reliable structure for producing effective and learner-centered materials.

The validation of instructional materials is equally critical to ensure their quality and acceptability. Torre Franca (2017) demonstrated that validated self-instructional modules in mathematics significantly improved students' performance in rational expressions and variations. Gayagay (2014) reported that a validated Grade 7 mathematics package was effective in strengthening student mastery. Rogayan and Dollete (2019) developed and validated a science workbook that enhanced learner engagement, while Rivera (2023) showed that a validated Grade 7 mathematics workbook improved proficiency in solving linear equations. Inocencio and Calimlim (2021) likewise validated a Grade 8 science workbook, reporting significant post-test gains. These findings demonstrate that validation is indispensable in confirming the usability, accuracy, and effectiveness of instructional materials.

Despite these contributions, certain gaps remain in the literature. While numerous modules and workbooks have been developed and validated, few have specifically focused on bilingual mathematics resources for Grade 7 learners. Most studies addressed either general instructional materials or monolingual modules, leaving limited exploration of bilingual approaches that integrate both Filipino and English. Additionally, there has been little emphasis on combining bilingual accessibility with a systematic design framework, such as ADDIE, particularly in the Philippine context.

In response to these gaps, the development of a bilingual Grade 7 mathematics workbook is both timely and necessary. By applying the ADDIE model and subjecting the material to rigorous validation, this workbook seeks to address the persistent language barrier in mathematics instruction. Through the integration of Filipino and English, it aims to provide culturally relevant and accessible resources that improve comprehension, support mastery of least-learned competencies, and promote equity in mathematics education.

Methodology

Research Design

This study adopted a descriptive–developmental research design under the Research and Development (R&D) approach, specifically following the ADDIE model, which is widely used in education to create, refine, and evaluate instructional programs and materials (Branch, 2010). This design was appropriate since the study aimed to develop and evaluate a bilingual, activity-based, learner-centered, and competency-based Grade 7 Mathematics workbook.

Quantitative data were gathered using Likert-scale questionnaires to evaluate the workbook's content validity, acceptability, and usability as perceived by pre-service teachers. In addition, selected comments were collected after the rating process and were used solely to support and explain the quantitative results. The development process followed the ADDIE model, which provided a structured framework for producing instructional materials (Clark, 2015; Branch, 2010). Overall, this design was suitable for the study as it enabled the systematic creation, evaluation, and refinement of the workbook, ensuring that the material was aligned with instructional objectives and responsive to learners' needs.

Respondents

This study employed purposive sampling, a non-random technique used to select participants who possess specific characteristics relevant to the research objectives (Tajik et al., 2024). The sample consisted of fifty (50) Grade 7 non-STE students from Banisil National High School, a public secondary school located in the Tumbler District, Division of General Santos City. The school caters to diverse learners from surrounding communities and implements the K–12 curriculum under the Department of Education. The participants met the following selection criteria: (1) bona fide students of Banisil National High School for AY 2024–2025; (2) enrolled as Grade 7 non-STE students; and (3) taking Mathematics at the time of the study.

Instrument

In the development and validation of the Grade 7 Mathematics bilingual workbook, three key instruments were employed: a diagnostic test, an expert validators' checklist, and a pre-service teachers' checklist. The 40-item diagnostic test was constructed based on the Grade 7 Mathematics Quarter 4 learning competencies to determine students' least-learned skills. It provided baseline data that guided the identification of learning gaps and informed the content development of the workbook.

The instrument underwent rigorous validation, ensuring both content validity—alignment with curriculum standards—and construct validity—accurate measurement of intended competencies. Three expert validators reviewed the test items, which were adapted from Department of Education (DepEd) materials, and confirmed them to be highly valid and appropriate for identifying students' learning needs.

To further ensure the quality of the instructional material, an expert validator's checklist using a Likert-scale format was utilized to assess both content validity and acceptability. The validation panel consisted of five experts, including three Mathematics educators and two Language specialists, all holding master's degrees. They evaluated the workbook based on clearly defined criteria, including alignment with curriculum standards, mathematical accuracy, clarity of presentation, cultural relevance, and the effectiveness of bilingual integration. The levels of validity and acceptability were categorized into five scales ranging from "very highly valid/acceptable" to "very little/not at all valid/acceptable." This structured evaluation enabled a comprehensive and systematic assessment of the workbook's pedagogical soundness and contextual appropriateness.

In addition, a pre-service teacher's checklist was employed to gather practical insights on the usability of the developed workbook. This adapted instrument was administered to eleven (11) Bachelor of Secondary Education majors in Mathematics during the Academic Year 2025–2026. The respondents assessed the material in terms of usability, clarity, engagement, and overall effectiveness in supporting teaching and learning processes. Their feedback provided valuable, practice-oriented perspectives that complemented the expert evaluations. The comments and suggestions gathered were subsequently used to refine and enhance the workbook, ensuring its relevance, functionality, and responsiveness to the needs of both teachers and learners in actual classroom settings.

Procedure

Data processing was carried out in five phases based on the ADDIE model: The procedures followed in the ADDIE model began with the Analysis phase, wherein permission was formally secured from school authorities to conduct the diagnostic test, then the instruments were gathered, and the diagnostic test was administered. A diagnostic test was conducted among 50 Grade 7 students taking Mathematics 7 in AY 2024–2025. This determined the least-learned competencies of the students, which served as the basis for the development of the workbook.

In the Design phase, learning objectives, assessment instruments, and content were selected based on the gathered data from the diagnostic test for the workbook. Each worksheet in the workbook contained the following parts: introductory statement, learning outcomes, lesson introduction, sample problems, and learning tasks.

During the Development phase, the worksheets were developed to be included in the workbook in both Filipino and English. The activities were student-centered and reflective in nature, with the intent of improving student learning. In the Implementation phase, the workbook was subjected to expert validation to gauge its content validity and level of acceptability. Five teachers—three Mathematics teachers and two language teachers—were requested to complete the expert validators' form. The pre-service teachers analyzed the developed workbook. Finally, in the Evaluation phase, revisions were made, and a final evaluation of the bilingual Grade 7 Mathematics workbook was conducted based on the feedback gathered from the validation and review processes.

Data Analysis

This study used the weighted mean to analyze the students' scores in different learning competencies, and the Mean Percentage Score (MPS) bracket to identify the least-learned competencies in the diagnostic test. The Mean Percentage Score (MPS) served as the foundation for the development of the workbook. Moreover, this study utilized weighted means and descriptive statistics to summarize the levels of validity and acceptability of the bilingual workbook.

Furthermore, this study gathered responses from pre-service teachers through the pre-service teachers' checklist, which included both rating items and open-ended feedback regarding the usability of the developed workbook. The comments provided by the respondents were reviewed and used to support and interpret the quantitative results, particularly in relation to the workbook's clarity, usefulness, engagement, and overall effectiveness.

The analysis results were used to guide the refinement of the bilingual workbook, especially in terms of improving the selection of learning competencies based on the least-learned competencies identified in the diagnostic test. The implications were discussed in the context of bridging mathematics learning through the use of two languages, boosting students' confidence in learning mathematics with the support of both their first and second language, allowing students to access concepts with greater clarity, and improving students' performance—particularly in their least-learned competencies—by providing scaffolding that supports both language and content mastery.

Ethical Considerations

The study was reviewed and approved by the Institutional Ethics Review Committee of Mindanao State University – General Santos City, which certified it as exempt from full ethics review (Approval No. 042-2025-MSUGSC-IERC, February 21, 2025). The informed consent and assent were obtained from all participants, participation was voluntary, and confidentiality was strictly maintained in compliance with institutional and national ethical guidelines.

Results and Discussion

This section presents the analysis and interpretation of the data gathered to address the research problems. The various results are presented in the succeeding tables with corresponding discussions and explanations.

Research Question 1: What are the least learned competencies of Grade 7 students in Mathematics?Table 1. *Least Learned Competency of Grade 7 Students in Mathematics*

<i>Learning Competencies</i>	<i>Mean Percentage Score</i>	<i>Decision</i>
1. Describe the set of integers.	28.4 %	LM
2. Use positive and negative numbers to describe directions or opposites in real-life situations.	77.2 %	MTM
3. Locate integers on the number line.	36.4 %	AM
4. Compare and order integers.	36.8 %	AM
5. Add and subtract integers; using concrete models (e.g., counters, integer chips), pictorial models (e.g., bar models, number lines), and with integers written as numerals.	53.6 %	AM
6. Multiply and divide integers.	57.2 %	AM
7. Simplify numerical expressions involving integers using number properties and the order of operations (GEMDAS).	32.8 %	LM
8. Identify the absolute value of an integer, and its meaning on the number line.	31.6 %	LM

Legend: 96-100% Mastered (M); 86-95% Closely Approximating Mastery (CAM); 66-85 % Moving Toward Mastery (MTM); 35-65 % Average Mastery (AM); 15-34 % Low Mastery (LM); 5-14 % Very Low Mastery (VLM); 0-4 % Absolutely No Mastery (ANM)

Table 1 shows the mastery percentage scores (MPS) of Grade 7 students in Quarter 3: Numbers and Algebra. Students achieved Average Mastery in competencies involving the application of integers in arithmetic operations, while Low Mastery was observed in foundational skills such as describing the set of integers (M=28.4%), simplifying numerical expressions using GEMDAS (M=32.8%), and identifying absolute value (M=31.6%).

The results indicate specific conceptual gaps that require targeted instructional interventions. Foundational competencies like describing integers are critical for understanding more complex mathematical concepts (Vista, 2023). The present study found that this competency was among those with the Low Mastery levels, consistent with Torigoe and Gladding (2007), who found that students tend to perform better on numeric problems than on equivalent symbolic tasks, a challenge further compounded by low conceptual knowledge and inconsistent practice in symbol manipulation.

In contrast, Average Mastery levels were observed in competencies involving the application of integers in the four fundamental operations. This improvement may be attributed to the use of physical models such as counters and visual tools like number lines. Similarly, Akhter and Akhter (2018) reported that students often perceive mathematics as difficult and unrewarding, which may lead to avoidance of the subject and, consequently, hinder the development of essential skills and mastery of key competencies.

Research Question 2: What is the content validity of the developed Mathematics Grade 7 Bilingual Workbook in terms of: objectives, key concepts, direction/instructions, practical exercises, reflections and topics?Table 2. *Content Validity of the Developed Mathematics Grade 7 Bilingual Workbook*

<i>Indicator</i>	<i>Weighted Mean</i>	<i>Interpretation</i>
Objectives		
1. The objectives are clearly stated in behavioral form.	4.80	Very Highly Valid
2. The objectives are well-planned, formulated, and organized.	4.40	Highly Valid
3. The objectives stated are specific, measurable, and attainable.	4.60	Very Highly Valid
4. The objectives are relevant to the topics of each lesson of the modules.	5.00	Very Highly Valid
5. The objectives take into account the needs of the students	4.80	Very Highly Valid
Mean	4.72	Very Highly Valid
Key Concepts		
1. The concepts give insights and ideas about what the activity is all about.	4.80	Very Highly Valid
2. It provides background of concepts and information about the topics to be solved.	4.60	Very Highly Valid
3. The concepts arouse students' interest to solve the exercises.	4.60	Very Highly Valid
4. It attracts students' attention.	4.60	Very Highly Valid
Mean	4.65	Very Highly Valid
Directions/Instructions		
1. Instructions are simple and clear.	5.00	Very Highly Valid
2. Directions are easy to follow.	4.80	Very Highly Valid
3. It is properly sequenced.	4.80	Very Highly Valid
4. Directions can be done independently.	4.80	Very Highly Valid
Mean	4.85	Very Highly Valid
Practical Exercises		
1. The exercises have relevance to the objectives.	4.60	Very Highly Valid
2. It is adequate to develop students' mathematical knowledge and	4.60	Very Highly Valid

skills.		
3. The exercises are appropriate to students' abilities.	4.60	Very Highly Valid
4. The exercises are sufficient enough to determine the mastery level of students.	4.40	Highly Valid
Mean	4.55	Very Highly Valid
Reflections and Topics		
1. It motivates students to express their learning experience.	4.40	Highly Valid
2. It gives insights to teachers if the students need remediation or enrichment.	4.80	Very Highly Valid
3. The topics are clearly organized.	4.80	Very Highly Valid
4. The topics are well constructed.	4.80	Very Highly Valid
5. The topics are logically presented.	5.00	Very Highly Valid
Mean	4.76	Very Highly Valid
Overall Mean	4.77	Very Highly Valid

Legend: 4.20 - 5.00, Very Highly Valid; 3.40 - 4.19, Highly Valid; 2.60 - 3.39, Valid; 1.80-2.59, Less Valid; 1.00 - 1.79, Very Less Valid

Table 2 presents the content validity of the developed bilingual workbook, evaluated by five expert validators across five key criteria: Objectives, Key Concepts, Directions/Instructions, Practical Exercises, and Reflections/Topics. The workbook received an overall weighted mean of 4.77, interpreted as Very Highly Valid, indicating strong agreement among validators on the quality and appropriateness of the content.

The Directions/Instructions component received the highest rating ($M=4.85$), reflecting that instructions are simple, clear, properly sequenced, and can be followed independently, supporting effective learner engagement. The Objectives also scored highly ($M=4.72$), demonstrating that learning goals are clear, specific, measurable, relevant to topics, and aligned with student needs.

For Reflections/Topics, the workbook achieved a mean of 4.76, suggesting it provides activities that promote critical thinking, personal engagement, and offer teachers insight for remediation or enrichment. Key Concepts scored 4.65, indicating the content is accurate, provides sufficient background, sparks interest, and attracts attention. Practical Exercises had the lowest mean (4.55), showing that while exercises are relevant, appropriate, and adequate to develop skills, there is room for more varied or enriched activities to reinforce learning.

These findings align with previous studies highlighting the importance of well-designed instructional materials in supporting effective teaching and learning. Gayagay (2014) emphasized that a valid workbook enhances comprehension and engagement, while Isola (2010) and Abdu-Raheem (2014) noted that structured instructional materials help teachers deliver lessons logically and clearly. The high ratings across all criteria confirm that the developed bilingual workbook is a valid instructional tool for Grade 7 Mathematics.

Table 3. Content Validity Index

Items	Expert in Agreement	CVR
1. The objectives are clearly stated in behavioral form.	5	1
2. The objectives are well-planned, formulated, and organized.	5	1
3. The objectives stated are specific, measurable, and attainable.	5	1
4. The objectives are relevant to the topics of each lesson of the modules.	5	1
5. The objectives take into account the needs of the students	5	1
6. The concepts give insights and ideas about what the activity is all about.	5	1
7. It provides background of concepts and information about the topics to be solved.	5	1
8. The concepts arouse students' interest to solve the exercises.	5	1
9. It attracts students' attention.	5	1
10. Instructions are simple and clear.	5	1
11. Directions are easy to follow.	5	1
12. It is properly sequenced.	5	1
13. Directions can be done independently.	5	1
14. The exercises have relevance to the objectives.	5	1
15. It is adequate to develop students' mathematical knowledge and skills.	5	1
16. The exercises are appropriate to students' abilities.	5	1
17. The exercises are sufficient enough to determine the mastery level of students.	5	1
18. It motivates students to express their learning experience.	5	1
19. It gives insights to teachers if the students need remediation or enrichment.	5	1
20. The topics are clearly organized.	5	1
21. The topics are well constructed.	5	1
22. The topics are logically presented.	5	1
Total CVR		22
CVI		1

Note: CVR – Content Validity Ratio, CVI – Content Validity Index

Table 3 presents the results of the Content Validity Index (CVI) analysis for the 22 items evaluated by five experts. The results show that all experts agreed on the validity of all items, giving each a CVR value of 1.00 and an overall CVI of 1.00. Based on the criteria

by Polit and Beck (2006) and Lynn (1986), the acceptable CVI for instruments rated by three to five experts should be 1.00. Thus, the obtained CVI indicates excellent content validity, confirming the content validity of the scale.

Research Question 3: What is the level of acceptability of the workbook in terms of: clarity, usefulness, language and style, illustrations, presentations, and suitability?

Table 4. *Level of Acceptability of the Workbook*

Indicator	Weighted Mean	Interpretation
Clarity		
1. The information is clear and simple.	4.80	Very Highly Acceptable
2. The language used is clear and easy to understand.	4.60	Very Highly Acceptable
3. The concepts for each activity are arranged logically to ensure that there is no duplication.	4.80	Very Highly Acceptable
Mean	4.72	Very Highly Valid
Usefulness		
1. The materials prepare the students to think logically and critically.	4.60	Very Highly Acceptable
2. The concepts in the material are simple and comprehensible.	4.80	Very Highly Acceptable
3. The bilingual workbook as a whole, the enrichment activity is teachable.	4.80	Very Highly Acceptable
4. The material provides opportunities for the development/ enhancement of mathematical skills.	5.00	Very Highly Acceptable
5. The learning contents provide adequate information on the topics presented.	4.60	Very Highly Acceptable
6. It encourages the students to become actively involved in the learning activities.	4.60	Very Highly Acceptable
7. It stimulates the learners to intellectual activities	4.20	Highly Acceptable
8. The activities seek to relate new concepts from previous learning.	4.00	Very Highly Acceptable
Mean	4.58	Very Highly Acceptable
Language and Style		
1. The presentation is clear observing correct grammar	5.00	Very Highly Acceptable
2. The language is clear and comprehensive in terms of vocabulary	4.60	Very Highly Acceptable
3. There is sufficient familiar vocabulary to ensure learning	4.80	Very Highly Acceptable
4. The structure, style and format are appropriate to the target level	4.80	Very Highly Acceptable
Mean	4.80	Very Highly Acceptable
Illustrations		
1. Clear and simple	5.00	Very Highly Acceptable
2. Arouses students' interest making learning effective and enjoyable	4.60	Very Highly Acceptable
3. Provides concrete visual clues	4.60	Very Highly Acceptable
4. Guides students to follow direction	5.00	Very Highly Acceptable
5. Relevant to the topic	5.00	Very Highly Acceptable
Mean	4.84	Very Highly Acceptable
Presentations		
1. Topics presented in logical and orderly sequences.	5.00	Very Highly Acceptable
2. The direction is concise, readable and easy to follow.	4.80	Very Highly Acceptable
3. Topics fit the sequence of the course.	5.00	Very Highly Acceptable
Mean	4.93	Very Highly Acceptable
Suitability		
1. The activity takes in consideration the varying attitudes and capabilities of the learner.	4.40	Highly Acceptable
2. The activities are suitable to the subject matter.	5.00	Very Highly Acceptable
3. The activities are relevant, interesting and self-motivating to the learner.	4.80	Very Highly Acceptable
4. The use of enrichment activity is adaptable to classes with a large number of pupils.	4.80	Very Highly Acceptable
Mean	4.75	Very Highly Acceptable
Overall Mean	4.74	Very Highly Acceptable

Legend: 4.20 - 5.00, Very Highly Acceptable; 3.40 - 4.19, Highly Acceptable; 2.60 - 3.39, Acceptable; 1.80 - 2.59, Less Acceptable; 1.00 - 1.79, Not at All Acceptable

Table 4 presents the level of acceptability of the developed bilingual workbook as evaluated by expert validators in terms of Clarity, Usefulness, Language and Style, Illustrations, Presentations, and Suitability. The workbook obtained an overall mean of 4.74, interpreted as Very Highly Acceptable, indicating strong agreement among validators on its quality and instructional appropriateness.

The Presentations component received the highest rating ($M = 4.93$), reflecting that the topics are logically and orderly sequenced, clearly presented, and aligned with the course structure. The Illustrations also scored highly ($M = 4.84$), demonstrating that visuals are clear, relevant, and effective in guiding learners and enhancing understanding.

For Language and Style, the workbook achieved a mean of 4.80, indicating that the language is appropriate for Grade 7 learners, with correct grammar, sufficient vocabulary, and a clear instructional format. Suitability scored 4.75, suggesting that the activities are

appropriate to learner needs, relevant to the subject matter, and adaptable to classroom settings. Clarity obtained a mean of 4.73, showing that the content is well-organized, easy to understand, and logically presented. Usefulness had the lowest mean (4.58), indicating that while the workbook promotes skill development and learner engagement, there is still room for improvement in enrichment and higher-order thinking activities.

These results are consistent with the findings of Gayagay (2014), who reported that bilingual instructional materials developed with expert input are highly acceptable and effective in enhancing teaching and learning. Overall, the workbook demonstrates strong potential as a pedagogical tool that supports both conceptual understanding and learner engagement.

Research Question 4: What are the thoughts of pre-service teachers in improving the usability of the developed bilingual workbook?

Table 5. Thoughts of Pre-Service Teachers in Improving the Usability of the Developed Bilingual Workbook

<i>Criteria</i>	<i>Mean</i>	<i>Verbal Interpretation</i>
1. The instructions are easy to understand.	4.82	Very High
2. The learning objectives are attainable	4.73	Very High
3. Varied activities are evident.	4.55	Very High
4. The graphic organizers enhance interest.	4.45	Very High
5. The material exhibits a visually appealing and stimulating format.	4.64	Very High
6. The activities enhance understanding of the lesson.	4.73	Very High
7. The students can enjoy answering the activities.	4.36	Very High
8. The material facilitates developing high level mathematical problem solving and thinking skills.	4.73	Very High
9. The activities increase interest in Numbers and Algebra.	4.27	Very High
10. The material enhances mathematical understanding and skills.	4.73	Very High
Total Mean	4.60	Very High

Legend: 4.20 - 5.00 Very High, 3.40 - 4.19 High, 2.60 - 3.39 Average, 1.80 - 2.59 Low, 1.00 - 1.79 Very Low

Table 5 presents the thoughts of pre-service teachers in improving the usability of the developed bilingual workbook, with selected comments provided to support the ratings. The comments were collected after the rating process and are presented to help explain the quantitative results.

Specifically, the pre-service teachers' thought is very high, indicating that the instructions were easy to understand, as reflected in the weighted mean of 4.82. This is supported by selected comments such as, "The instructions were straightforward, student-friendly, and easier to grasp since they were written in both English and Tagalog," and "The workbook provides clear and simple bilingual instructions that make each activity easy to follow."

Similarly, the pre-service teachers' thought is very high regarding the attainability of the learning objectives, with a weighted mean of 4.73. Comments suggest that "The objectives are clearly stated and realistically achieved through well-structured lessons and activities," and "The objectives are specific and serve as the target of the module."

The pre-service teachers' thought is also very high in terms of the variety of activities, as reflected by a weighted mean of 4.55. One comment noted that "The activities are very engaging and fun," while another suggested that "Yes, varied activities are evident but more diverse activities may still be included, since it is a workbook." These remarks support the rating while indicating areas for further improvement.

Moreover, the pre-service teachers' thought is very high regarding the use of graphic organizers in enhancing students' interest, as reflected in the weighted mean of 4.45. One comment stated that "The use of tables, charts, and number lines makes lessons more visually engaging and easier to understand," while another suggested that the graphic organizers may still be improved. These comments support the rating and suggest refinement of visual elements.

In terms of visual appeal, the respondents' thought is very high, with a weighted mean of 4.64. Comments such as "The clean layout and balanced bilingual design make the workbook attractive and motivating for students" support this result. A suggestion to include the SDG sign on the front page indicates a possible enhancement to further improve presentation and contextual relevance.

The pre-service teachers' thought is also very high regarding the effectiveness of the activities in enhancing students' understanding, with a weighted mean of 4.73. Comments suggest that "Each activity reinforces key mathematical concepts and helps deepen student comprehension," and that bilingual instructions support clearer understanding of the lesson.

Furthermore, the pre-service teachers' thought is very high regarding students' enjoyment of the activities, with a weighted mean of 4.36. Comments indicate that the activities are "relatable and interactive," though some suggest adding more visual presentations and examples. These remarks suggest that while enjoyment is generally high, engagement may still vary depending on learners' preferences.

In addition, the pre-service teachers' thought is very high regarding the development of higher-level mathematical thinking skills, with a weighted mean of 4.73. Comments suggest that the material supports mathematical thinking, comprehension, and problem-solving skills.

The pre-service teachers' thought is also very high regarding the workbook's potential to increase students' interest in Numbers and Algebra, which obtained the lowest weighted mean of 4.27 but still indicates a positive result. Some comments suggest that interest may vary among learners, while others indicate that bilingual and contextualized lessons can enhance motivation. These remarks support the rating while acknowledging variability in learner engagement.

Lastly, the pre-service teachers' thought is very high regarding the enhancement of mathematical understanding and skills, as reflected in the weighted mean of 4.73. Comments suggest that the workbook promotes critical thinking, problem-solving, and mathematical reasoning.

Overall, the pre-service teachers' thought is very high in terms of the usability of the bilingual workbook, which obtained an overall weighted mean of 4.60. Selected comments indicate that the bilingual format supports comprehension, engagement, and accessibility, particularly through the use of both English and Filipino in presenting mathematical concepts and instructions.

The pre-service teachers' feedback supports the quantitative findings on usability and aligns with the study of Adora (2014), which emphasized the importance of feedback in the development of mathematics workbooks. In both cases, the evaluation results suggest that the instructional material is acceptable and usable for classroom application. This consistency across findings supports the usability of the developed workbook.

Furthermore, the results may be understood through the lens of Cummins' Theory of Bilingualism and Vygotsky's Sociocultural Theory. Cummins emphasizes that learners' academic development in a second language is influenced by their first language proficiency. In this context, the bilingual format is expected to support comprehension by reinforcing concepts in both languages.

Similarly, Vygotsky's Sociocultural Theory highlights the role of language and support in learning. The workbook may serve as a structured instructional tool that guides learners as they engage with mathematical tasks. Through clear instructions, familiar language, and scaffolded activities, the material is expected to support learners as they progress toward independent problem-solving.

Conclusions

This study demonstrated that the developed bilingual Grade 7 Mathematics Workbook is a valid, acceptable, and usable instructional material for the Number and Algebra component of the curriculum, based on the perceptions of pre-service teachers. These findings directly address the study's objective of developing and evaluating a bilingual instructional resource. The results suggest that integrating English and Filipino in instructional materials is a practical approach to addressing language barriers commonly encountered in English-only resources. The workbook obtained very high ratings in content validity ($M = 4.77$) and acceptability ($M = 4.74$) from expert validators, as well as a high usability rating ($M = 4.60$) from pre-service teachers, indicating that the material is clear, relevant, and appropriate as a classroom supplement. The computed Content Validity Index ($CVI = 1.00$) further indicated perfect agreement among expert validators, reinforcing the workbook's strong content validity.

Beyond its linguistic accessibility, the bilingual workbook promotes an inclusive and learner-centered approach to mathematics instruction. Its clear bilingual directions, engaging visuals, and contextualized activities make mathematical concepts more relatable and comprehensible. This implies that language-sensitive instructional design can enhance conceptual understanding and learner engagement in mathematics (Abdulrahim & Orosco, 2020). The design aligns with the goals of the MATATAG Curriculum and Sustainable Development Goal 4 (Quality Education) by supporting equity and accessibility in learning materials. The findings have important implications for mathematics educators, curriculum developers, and material designers. The study highlights that incorporating bilingual and contextually relevant features in instructional materials can improve inclusivity and accessibility for diverse learners. It also demonstrates that instructional innovation can be achieved within existing frameworks without requiring extensive additional resources, contributing to the advancement of multilingual mathematics education.

However, despite these positive findings, the study has several limitations. It did not include empirical testing of the workbook's impact on student achievement, relied primarily on descriptive statistics, and involved a limited number of expert validators. These limitations may restrict the generalizability and practical validation of the results in actual classroom settings. Future research is recommended to utilize experimental or quasi-experimental designs to assess the workbook's effectiveness on learning outcomes, employ inferential statistics for broader analysis, and include a larger and more diverse group of validators. Furthermore, implementing the workbook in real classroom contexts and gathering feedback from in-service teachers and students are recommended to further refine and strengthen instructional value.

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