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Assessment of Grade 7 Students' Mathematical Learning Competencies: Basis for Instructional Material

Ann Jeline P. Magmanlac[1], Anjel Mae C. Laurin[2], Rowena Imelda A. Ramos*[3], Cecilia F. Ronia*[4], Mary Grace L. De Guzman[5], Michelle T. Collado[6], Teofilo C. Esguerra[7], Leonardo B. Dorado[8]

Adventist University of the Philippines
riaramos@aup.edu.ph, cfronia@aup.edu.ph

ABSTRACT

Enhancing students' mathematical competency requires a deliberate and multifaceted approach that utilizes diverse instructional materials to engage learners, foster understanding, and encourage active learning. Addressing less frequently taught competencies in mathematics, however, poses a significant challenge. This quantitative-descriptive research used structured mathematics assessment test to evaluate the competencies of 67 Grade 7 students at a sectarian private school in the Philippines. The results showed that students' competency across various areas, especially in integers and polynomials, needs enhancement. This data provides a clear indication of which specific competency requires further development. Consequently, the study results served as the basis for the creation of supplementary instructional materials aimed at helping students master foundational concepts and improve in their weaker areas with guidance from their teachers.

Keywords: *mathematical competency, instructional materials, assessment evaluation*

INTRODUCTION

Math has been a fundamental part of human civilization for centuries, shaping much of what surrounds us today (Gordon & Hom, 2021). Even ancient cultures utilized this core science, which encompasses logic, arrangement, patterns, numbers, and proof, to their advantage. Despite its historical significance, mathematics remains a challenging subject, causing anxiety even among college students. Numerous studies have sought to address this issue, leading to the development of various tools aimed at enhancing students' understanding and mastery of the subject (Langoban, 2020). One such tool is instructional materials, which play a crucial role in improving the effectiveness of math teaching and learning (Umuhoza & Uworwabayeho, 2021).

Despite these efforts, the Department of Education has received criticism for inadequate printed instructional materials in some subjects, including math for grades 6-8, and 10, across public schools in the country (Mateo, 2019). Many schools struggle to identify specific areas of weakness in students' math competencies, which hinders their ability to provide targeted instructional materials and make necessary improvements.

Education Secretary Leonor Magtolis Briones highlighted the importance of creating effective learning materials in her statement following the Department of Education's collaboration with Huawei Philippines and the Banco de Oro (BDO) Foundation (Malipot, 2020). Briones emphasized the need for developing high-quality, competency-based instructional materials (IMs). However, even though these IMs were designed with competencies in mind, not all learning competencies at each grade level were fully addressed (Mendiola & Estonanto, 2022). This underscores the need for continued development, especially for the less-taught math competencies.

A study found that the inadequacy of materials in textbooks contributes to difficulties faced by secondary school teachers in using instructional materials effectively (Dhakal, 2020). Another study revealed that many instructional materials are poorly designed, not cost-effective, and do not sufficiently support students' intellectual growth (Onyia, 2013). Furthermore, research indicates a significant difference in performance between students who used instructional materials and those who did not, with the former group demonstrating better comprehension and academic achievement (Adebule & Ayoola, 2016; Adalikwu & Iorkpilgh, 2013).

For instructional materials to be effective, teachers need ample time to tailor learning competencies to the needs of their students. Evaluating students in various areas of mathematics helps determine which areas require additional support. Although it is expected that math teachers use a range of teaching aids, research suggests that this expectation is not always met. Existing studies have explored issues such as students' low performance in math, the difficulty of learning the subject, and the use of instructional materials. However, there is limited research focusing on developing instructional materials tailored to students' specific needs to address their weaknesses.

The current research gap lies in the lack of specialized instructional materials developed after assessing Grade 7 students' mathematical learning competencies. Although there are numerous studies on mathematics education, few have evaluated students' learning competencies in various math areas in the province of Cavite, particularly in private schools. This research aims to fill this gap by assessing Grade 7 students' mathematical competencies in several areas and developing supplemental learning materials for areas where students did not meet expectations. The results will serve as a framework for creating instructional materials that better support foundational mathematical competencies.

LITERATURE REVIEW

Competencies are the integrated combination of knowledge, skills, and attitudes that students develop and apply to achieve success in learning, everyday life, and professional environments (*Students Learning Through Competencies, Alberta Regional Professional Development Resources*, 2019). In mathematics, competencies include communication, mathematical reasoning, representation, devising methods, and using symbolic, formal, and technological language and operations. These skills are transferable and represent a range of attributes that individuals possess to varying degrees. Recent studies suggest that individuals who develop and effectively use these competencies are better equipped to apply their mathematical knowledge to solve contextualized problems (Turner, 2010).

The Most Essential Learning Competencies (MELCs) are the key learning objectives identified as critical across all grade levels, from elementary through senior high school. These competencies were developed and implemented during the COVID-19 pandemic as part of the Department of Education's Learning Continuity Plan. To ensure clarity and effective use, the Department of Education issued memorandum DM-CI-2020-000. Although the MELCs were introduced in response to the pandemic, they continue to be the primary reference for schools, school division offices, and regional offices. (*New Sets of Teacher's Guide in All Subject Areas for SY 2020-2021*, 2020).

In the Grade 7 mathematics curriculum, there are sixty-four (64) learning competencies outlined by the MELCs for the first through fourth quarters. These competencies are organized into a comprehensive framework based on four key areas: measurement, patterns, algebra, geometry, statistics, and probability. Each key area includes a list of the most essential learning competencies relevant to that area (K–12 Curriculum Guide Mathematics, 2016).

The seventh grade is a pivotal year in a student's mathematical education, transitioning from basic concepts to more complex ideas. To support this transition, students require a solid foundation and effective instructional strategies. This study focuses on how well-designed resources can enhance learning outcomes, student engagement, and teacher effectiveness, specifically in 7th grade mathematics education.

Mathematics education requires instructional materials that challenge students with complex problems and encourage critical thinking. These skills are essential for logical knowledge acquisition and preparing students for independent learning. When students tackle and solve difficult tasks, their confidence in their mathematical abilities grows. Successfully overcoming these challenges fosters resilience and a sense of accomplishment, which enhances their willingness to engage with other difficult projects, both in mathematics and in other subjects. This transferable confidence contributes to their overall academic growth (Sachdeva & Eggen, 2021).

Research indicates that students using instructional materials tend to perform better academically compared to those who do not (Abubakar, 2020). Another study found that

mathematical learning materials positively impact students' learning outcomes, as evidenced by improved pre- and post-test results (Taufik et al., 2019). Hands-on learning materials increase information retention and make learning more engaging and interactive. By serving as a conduit for knowledge transfer between teachers and students, these materials help students visualize concepts, reduce boredom, and enhance student-teacher interaction during lessons (Adalikwu & Iorkpilgh, 2013).

Given the critical role of instructional materials in supporting student success, ongoing research is needed to identify areas for improvement and to develop resources that address these needs. This research aims to create materials that effectively align with and achieve the Most Essential Learning Competencies (MELCs).

METHODS

This quantitative research employed a descriptive design to collect and analyze numerical data, aiming to identify trends and averages for broader interpretation (Bhandari, 2022). The study used a test to assess the mathematical competencies of Grade 7 students at a sectarian private school during the 2022–2023 academic year. The research sample consisted of 67 participants from two available sections, selected through convenience sampling based on accessibility rather than random or systematic methods.

The researchers initially created a 35-item test covering seven areas: sets, real numbers, integers, rational numbers, measurement, algebraic expressions, and polynomials. These areas were chosen based on the Most Essential Learning Competencies (MELCs) distributed by the Department of Education to guide the selection and implementation of learning strategies. A table of specifications (TOS) aligned with the MELCs was developed to detail the learning area, learning competency, and distribution of items in each area.

The test items were evaluated by nine professors from the mathematics and English fields before being distributed. The pilot study revealed that the instrument's internal consistency, measured by Cronbach's alpha, was below the acceptable threshold of 0.6. This indicated poor item correlation and required revision of the questions. Consequently, the test was revised to 22 items, with 3 to 4 items per area, to better measure students' mathematical competencies.

The test results were analyzed using Excel and JAMOVI for descriptive and independent t-test analyses. Descriptive statistics were used to report the frequency, mean, and standard deviation of scores, while the independent t-test assessed whether differences in competency levels across different areas were statistically significant. The mean scores per area were computed and transmuted into their percentage equivalent. The scoring system classified the competency into five levels: Excellent (81%-100%) for the highest level of competency, Above Average (61%-80%) for strong but not exceptional performance, Average (41%-60%) for meeting expectations, Below Average (21%-40%) for noticeably inadequate performance, and Inadequate (0%-20%) for performance far below acceptable standards

(Guskey, 2003; Black & William, 1998; Angelo & Cross, 1993). This system provides a clear framework to evaluate and distinguish between different levels of understanding and skill. Following data collection, correct responses were scored as 1 and incorrect responses as 0.

RESULTS AND DISCUSSION

The evaluation of mathematical competencies was structured using the mean scores and the percentage equivalent. Table 1 presents analyses and interpretations of mean in several mathematics' areas.

Table 1
Level of Mathematical Competency in the Seven Areas of Mathematics

Area in Mathematics	Number of Items	Mean	SD	Percentage Equivalent	Verbal Interpretation
Sets	3	1.866	0.903	62.20	Above Average
Real Numbers	3	2.149	0.857	71.63	Above Average
Integers	3	1.075	0.942	35.83	Below Average
Rational Numbers	4	1.851	1.048	46.28	Average
Measurement	3	1.627	0.868	54.23	Average
Algebraic Expressions	3	1.373	0.982	45.77	Average
Polynomials	3	0.776	0.820	25.87	Below Average

Scoring System: *excellent = 81%-100%; above average = 61%-80%; average = 41%-60%; below average = 21%-40%; inadequate = 0%-20%*

The results reveal a varied level of mathematical competency across seven different areas. The students scored above average, with percentage equivalents of 62.20% and 71.63%, respectively. This describes a solid understanding or above-average competency in these areas.

On the other hand, students obtain low mean scores in integers with a percentage of only 35.83% and even lower in polynomials with a percentage of 25.87%. This suggests below-average competency in these areas, suggesting targeted intervention.

The other areas, including rational numbers (46.72%), measurement (54.23%), and algebraic expressions (45.77%), are assessed as average. These values signify an acceptable grasp of these concepts while indicating room for improvement.

In summary, the results highlight that while students have above-average understanding of sets and real numbers, they face difficulties with integers and polynomials. Additionally, the high standard deviations in all the areas further suggest considerable variability in students' competencies, emphasizing the need for targeted interventions to enhance understanding of the different areas.

Table 2 described the comparison of competency levels across the seven areas of mathematics. It focused on how these levels varied in terms of gender,

Table 2

Level of Mathematical Competency in the Seven Areas of Mathematics Across Gender

Area in Mathematics	Gender	No. of Items	Mean	SD	Perc. Equi.t	Verbal Interpretation	t	df	p
Sets	Female	3	2.080	0.909	69.33	Above Average	1.514	65	0.135
	Male		1.738	0.885	57.93	Average			
Real Numbers	Female	3	2.240	0.831	74.67	Above Average	0.666	65	0.508
	Male		2.095	0.878	69.83	Above Average			
Integers	Female	3	1.280	0.843	42.67	Average	1.386	65	0.171
	Male		0.952	0.987	31.73	Below Average			
Rational	Female	4	1.920	1.077	48.00	Average	0.415	65	0.680
Numbers	Male		1.810	1.042	45.25	Average			
Measurement	Female	3	1.600	0.816	53.33	Average	-0.194	65	0.847
	Male		1.643	0.906	54.77	Average			
Algebraic	Female	3	1.440	1.003	48.00	Average	0.427	65	0.671
Expressions	Male		1.333	0.979	44.43	Average			
Polynomials	Female	3	0.560	0.583	18.67	Inadequate	-1.626	65	0.109
	Male		0.905	0.958	30.17	Below Average			

For sets, females are categorized as being above average. On the other hand, males scored slightly lower, which is considered average. However, statistically, the comparison of the means of 2.080 (SD = 0.909) and 1.738 (SD = 0.885) did not cause a significant difference with t = 1.514 and p = 0.135.

In the area of real numbers, females obtained a mean score of 2.240 (SD = 0.831), which is equivalent to 74.67%, while males mean score is 2.095 (SD = 0.878), which is equivalent to 69.83%, both indicating above-average competencies. Thus, the difference is not statistically significant with a p-value of 0.508.

For the area of integers, females are classified as having average competency (M = 1.280 = 42.67%, SD = 0.843), while males are categorized as having below-average competency (M = 0.952 = 31.73%, SD = 0.987). Despite this, the difference was not statistically significant (p = 0.171).

In the area of rational numbers, females obtained a mean score of 1.920 (SD = 1.077), equivalent to a competency percentage of 48%. Males scored a little lower mean score of 1.810 (SD = 1.042), which is equivalent to 45.25%. These scores are both attributed to average competencies; hence, the difference is not statistically significant with a p-value of 0.680.

For measurement, the difference between the scores of females (M = 1.600, SD = 0.816) and males (M = 1.643, SD = 0.906) is also not significant with a p-value of 0.847. Both genders obtained an average competency in this area of mathematics.

In algebraic expression, both genders were classified with average competency levels. Females mean score is 1.440 (SD = 1.003) with an equivalent percentage of 48.00%, while males mean score is 1.333 (SD = 0.979) with a percentage equivalent of 44.43%. The difference in these scores is not statistically significant (p = 0.671).

Last of all, in the area of polynomials, females were considered to have inadequate competency (M = 0.560 = 18.67%, SD = 0.583), while males scored with a slightly better mean (M = 0.905 = 30.17, SD = 0.958). However, the score difference is not statistically significant with p = 0.109.

Generally, the results show that females and males exhibit similar performance in most mathematical areas. This indicates no statistically significant differences between genders.

The assessment of the mathematical competencies revealed that Grade 7 students generally performed well in some areas, such as sets and real numbers. On the other hand, they struggle in areas like integers and polynomials. Generally, there is an average level of competency in the areas of rational numbers, measurement, and algebraic expressions. In the comparison of competency across genders, it was found out that males and females exhibit similar levels of competency across the areas of mathematics included in this study.

As implied by the name, supplementary educational materials are essential to students' learning. Pupils who receive instruction using instructional materials outperform those who do not in terms of academic performance (Abubakar, 2020). They serve as tools for reinforcement and review, allowing students to revisit and practice concepts in the taught subject. The idea of using educational materials was reinforced by Taufik et al. (2019). The usage of mathematical learning resources has an impact on students' learning results, according to his study. His claim was further supported by the pre- and post-test results of the pupils in his study, which revealed improved academic outcomes.

Using student workbooks as supplemental instructional materials can have a beneficial impact on making pupils learn (Utami et al., 2020). Thus, researchers came up with the idea for a workbook that was largely adapted from the DepEd Tambayan resources. A group of educators launched the website platform DepEd Tambayan with the goal of spreading their enthusiasm for teaching throughout the Filipino regions. It has offered adequately chosen content on a range of topics to guarantee improved learning resources.

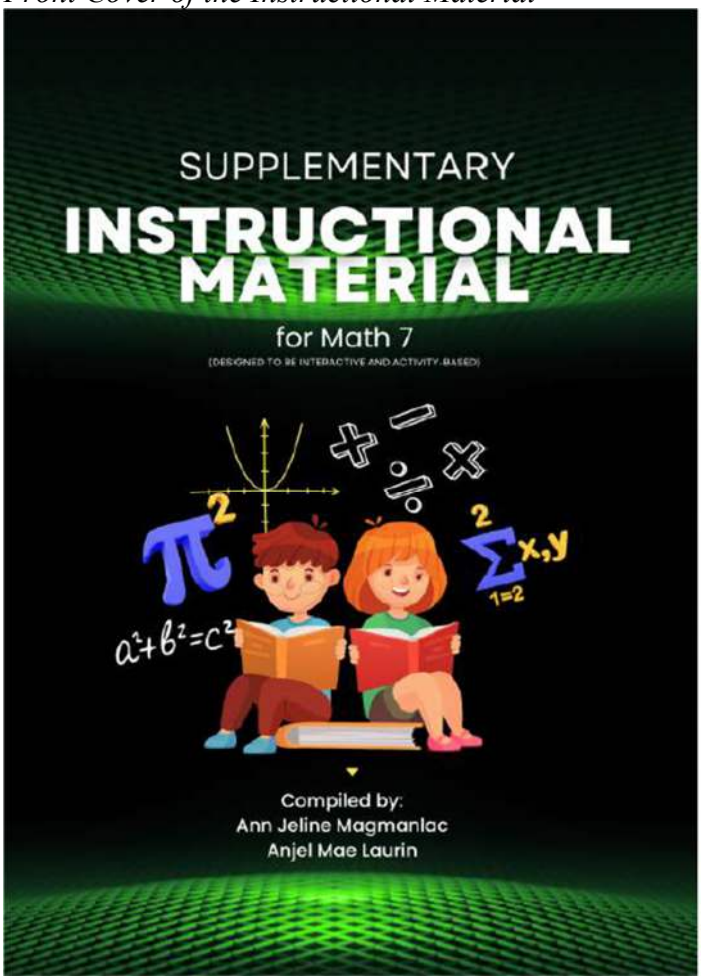
The information includes the topic, objectives of learning, and assessments, which are all available for free download but are only to be used for educational purposes. This learning material is composed of a variety of exercises that gradually increase in complexity, allowing students to practice and reinforce concepts at different levels. It requires students to solve problems step by step, helping them develop problem-solving strategies.

Based on the assessment's findings, the learning areas that require focus include polynomials and integers. The proposed supplementary instructional material contains a simple explanation of the topic and set of exercises that includes step-by-step guides to provide clear, logical guides for solving specific types of math problems, helping students build confidence and understanding.

The lessons and exercises in the supplementary instructional material were built around the underlying learning competencies for the two areas listed, which were based on the MELC. The learning competencies for the mathematics areas were carefully examined from the MELC to make sure that the subjects covered will aid in students' conceptual understanding and aid in their ability to successfully complete the tasks intended to help them attain the learning competency.

Figure 1

Front Cover of the Instructional Material



The Supplementary Instructional Material for Math 7 is a printed resource integrated and modified from the DepEd Alternative Delivery Mode-Self Learning Module (SLM) that contains exercises and activities to complete that will help improve your mathematical skills, giving you levels that encourage you to answer based on your learnings taught in a course or a textbook. It is designed as interactive and activity-based alongside textbooks. It includes topics that have simple explanations and guides for easy understanding of the process. You'll get a better understanding of mathematics fundamentals as well as knowledge of integers and polynomials as you consider real-world math applications.

This instructional material is a supplement to gain more practice to complement learning in a classroom, not a replacement for education in a classroom. You can concentrate on improving your arithmetic skills by raising the difficulty of your tasks as directed by your teacher. You can recognize the sections that are most pertinent to what you are learning if you are studying independently.

This supplementary instructional material can also be used alone as a stand-alone learning resource by going through each component. You can improve the learning process, develop your mathematical foundations, and reinforce your grasp of subject matter by applying practical application through this supplementary instructional material.

Every lesson has several sections. These sections include:

- **What I Need to Know** consists of the scope of the topic and the specific learning competency.
- **What I know** is the pre-assessment of your current learning. It is a set of activities that requires you to answer to review your previous knowledge.
- **Let's Learn** provides guidelines through a strategy to learn a specific math solving. It encourages you to answer the task to practice the concepts you learned.
- **What's New** introduces new important ideas and methods of the topic.
- **Try This** is another set of level-up tasks that require you to answer and practice more about your understanding of the topic.
- **Let's Learn More** consists of activities that provide more interactive and challenging tasks.

The box colors indicated for every exercise have categories:

Easy **Average** **Challenging**

As you read through this book, keep track of the arithmetic principles that come up again to help you deal with a variety of difficulties. These concepts will serve as the foundation for your math skills and will assist you in every case while calculating about math.

CONCLUSION, IMPLICATION, SUGGESTION, AND LIMITATIONS

Assessment of a seventh-grade student's learning competency in areas of mathematics is crucial to identifying which learning competency in every math topic they perform best and least on. Thus, in conclusion, individuals possess different strengths and weaknesses in different areas of math based on the result of their assessment. Therefore, instructions and supporting materials should be carefully constructed to ensure that learners retain the information and increase the attainment of learning outcomes.

In addition, gender is not significant in determining the level of mathematical learning competency of students. The issue is not with gender but rather with poor habits of learning math. The learner should try to gain knowledge by focusing and engaging in activities that capture their inquisitiveness. Effective math learning focuses on fostering the skills and mindset needed for continued learning and application of mathematics throughout life.

Students who independently explore and exert self-motivated efforts to gain knowledge will better retain that knowledge.

It is also recommended that math teachers utilize the instructional material among Grade 7 students. Since the developed instructional material focuses only on integers and polynomials, it is also recommended that a diverse range of materials in teaching, including digital resources, manipulatives, and multimedia tools, be utilized to strengthen the competency of all the areas of mathematics.

For future research, a study testing the effectiveness of the instructional material is recommended. Additionally, consider longitudinal studies to examine the long-term implications of creating instructional materials to provide more comprehensive and effective supporting materials. The number of respondents should be done with a larger population and numerous item-test to assess the learning competencies of students.

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