Learning Competencies as the Basis for Designing a Grade 1 Numeracy Workbook: Focus on Pictographs, Subtraction, and Patterns

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Abstract

The study aimed to design and develop intervention materials, specifically a Numeracy Workbook for Grade 1 learners at Pedro D. Duncano Elementary School, North Butuan District, Division of Butuan City, for the school year 2024–2025. A descriptive-developmental research design was employed to address research objectives to assess the extent of numeracy skills manifested by Grade 1 learners about three key competencies—interpreting pictographs without a scale, performing subtraction involving numbers less than 100, and recognizing repeating patterns. The study involved 30 learner-participants and three expert evaluators. Research instruments included a Summative Assessment aligned with content standards for the identified competencies. Data were analyzed using frequency counts, percentages, and weighted means. Findings revealed that the least learned competencies in Grade 1 Mathematics for the third quarter of SY 2024–2025 included interpreting pictographs and equivalent expressions, solving subtraction word problems, subtracting two-digit numbers within the range of 1–100, and performing subtraction using expanded form. These areas were identified as learning gaps and guided the content development of the numeracy workbook. As a result, the Numeracy Workbook was developed with focused lessons and activities on pictographs without a scale, equivalent expressions, subtraction in word problems, subtraction of two-digit numbers, and subtraction using expanded form. The intervention was designed and developed to improve learner engagement and mastery of these numeracy skills. Implementing the Numeracy Workbook is expected to enhance learners' understanding and appreciation of mathematical concepts such as data representation, subtraction strategies, and pattern recognition, thereby promoting stronger foundational numeracy aligned with higher academic standards.

Index Terms: Intervention Materials, Numeracy Skills, Numeracy Workbook. Pictographs

I.INTRODUCTION

Early numeracy encompasses foundational mathematical skills such as verbal counting, number recognition, quantity comparison, and basic operations like addition and subtraction. These skills are typically developed informally in early childhood through interactions with family members, peers, and community activities before formal schooling begins. As children enter school, these foundational skills are expected to be strengthened and expanded upon through formal instruction. However, in the Philippines, significant challenges in mathematics learning persist, particularly in early education. Data from the Programme for International Student Assessment (PISA) 2022 revealed that Filipino students scored an average of 355 in mathematics—only a marginal increase from 353 in 2018 and still well below the OECD average of 472. This suggests long-standing issues in mathematics education that need urgent intervention, especially at the foundational levels.

According to San Juan (2019), the Department of Education acknowledged the consistently low performance of Filipino learners in mathematics, further mirrored by results from the National Achievement Test. Several issues were identified, including the lack of appropriate learning materials, delayed distribution of resources, and teachers' limited capacity in instructional material development. The National Center on Improving Literacy (2023) also noted that these systemic issues contribute to the poor academic

performance of learners in mathematics. To address these concerns, DepEd issued Order No. 12, s. 2015, which introduced the Early Language, Literacy, and Numeracy Program. This program aims to enhance reading and numeracy skills among Kindergarten to Grade 3 learners through professional development and structured interventions such as Learning Action Cells (LAC). Furthermore, the Rapid Mathematics Assessment (RMA), mandated through DepEd Memorandum CT-2024-284, was introduced as a diagnostic tool to assess mathematical readiness and skills of learners from Grades 1 to 3.

Despite these efforts, results from the administration of the Rapid Mathematics Assessment (RMA) in Pedro D. Duncano Elementary School in August 2024 showed that a majority of Grade 1 learners failed to meet expected competency levels, particularly in areas like pictographs, two-digit subtraction, and repeating patterns. This performance gap highlights the inadequacy of existing instructional materials and support strategies during the third quarter of the academic year. The repeated struggles of learners in mastering these competencies signal a need for more focused and accessible learning tools tailored to their specific learning needs.

In response to these gaps, this study was conceptualized to design and develop numeracy workbook focusing on the least mastered competencies—pictographs, two-digit subtraction, and repeating patterns—among Grade 1 learners at Pedro D. Duncano Elementary School. The workbook serves as a supplementary instructional tool aligned with the third-quarter curriculum, aiming to improve learners' mathematical literacy and support teachers in delivering more effective lessons. By addressing specific gaps in numeracy skills, this intervention seeks to enhance learning outcomes and contribute to the broader goal of strengthening early mathematics education in the Philippines.

II. RESEARCH ELABORATIONS

This study was anchored on three main theories: Problem-Based Learning Theory (Bruner, 1960), Operant Conditioning Theory (Skinner, 1990), and Semiotic Theory (Peirce, 1900). These theories guided the development and utilization of the numeracy workbook based on the learning competencies, highlighting the importance of mathematical concepts that Grade 1 learners will possess. Problem-Based Learning Theory, introduced by Jerome Bruner in 1960, highlighted the focus on acquiring knowledge through working on and solving real-life problems. According to Bruner, learners construct new ideas based on their current and past knowledge. In Problem-Based Learning, learners are presented with real-life problems and encouraged to discover and explore answers, engaging in meaningful learning that connects to their prior knowledge. Using a numeracy workbook in the content of the learning competencies, this study aligns with Bruner's theory by leveraging the learners' mathematical skills. These learning competencies make learners develop analytical thinking and problem-solving skills by guiding their inquiry without directly giving answers. The interaction of teachers and learners and the use of the material make learning relevant and engaging. Another theory, the operant conditioning theory, was introduced by B.F. In the context of Mathematics, Skinner (1990) explains the strong foundation for using Mathematics workbooks as structured tools for reinforcing learning behaviors. Activity sheets on workbooks provided repetitive practice skills and immediate reinforcement in every correct response to the activity. The more exposure to specific activities given to learners, the more learners are excited to have positive reinforcement in every correct answer they have made in every activity. This promotes mastery and long-term retention of the topic being taught. This study is also embedded in the Semiotic Theory of Charles Sanders Pierce (1900), emphasizing the support in analyzing pictographs that are effective for young learners and designed to simplify and convey information efficiently. When combined with words, pictographs function as icons for images and symbols for text understanding through multimodal signs. Pierce's theory of semiotics is instrumental in understanding how visuals are used as an aid to learning and comprehension.

Furthermore, by using these problem-based learning and pictorial representations in the context of the numeracy workbook, the study helped learners develop a holistic understanding of numeracy concepts and build higher-order thinking skills, including analysis and synthesis while enhancing engagement and persistence in tackling problems. The theoretical frameworks of this study were built on Bruner's Learning Theory (1960), which implies the importance of the acquisition of knowledge through working on and solving real-life problems, Skinner's Operant Conditioning Theory (1990), which highlighted reinforcement of correct responses through repetition and feedback as well as shaping learners' performance through a sequence of challenging tasks. Pierce's Semiotic Theory (1900), which pictographs, bids a foundation for understanding how pictorial symbols convey meaning. These theories provided a strong foundation for using numeracy workbooks based on the learning competencies in the 3rd Quarter of Mathematics 1, developed and improved mathematical literacy among Grade 1 learners.

III.RESEARCH METHODOLOGY

This study employed a descriptive-developmental research design to develop and evaluate a numeracy workbook tailored for Grade 1 students in Butuan City, Philippines. The researchers began by identifying the least-mastered competencies among 30 Grade 1 students using a summative test designed by the Department of Education (DepEd). The assessment focused on key mathematical areas: pictographs, subtraction, and repeating patterns. These identified areas of difficulty served as the foundation for developing the numeracy workbook. Three experts evaluated the workbook: a Doctor of Education specializing in early childhood, a Master Teacher with extensive Grade 1 teaching experience, and a PhD holder in Mathematics Education. Their feedback played a critical role in assessing the quality and relevance of the material.

The study also underscored the growing role of technology in education. Specifically, it highlighted DepEd's partnership with Canva for Education, providing teachers free access to professional design tools. This initiative supports the creation of visually engaging and pedagogically sound learning materials. The literature review reinforced the value of integrating technology and aesthetically appealing resources—such as those created using Canva—in enhancing student engagement and understanding, particularly in mathematics. Data collected from the summative test and the expert evaluations were analyzed quantitatively. The following statistical tools were used**.** Frequency count and percentage distribution were used to determine the summative test's raw scores and performance distribution. Weighted mean was used to evaluate the workbook by calculating the average of scores assigned by the experts, considering the frequency of each score.

III. RESULTS AND DISCUSSION

This section presents the extent of numeracy skills manifested by Grade 1 learners in the summative test along with the learning competencies in the 3rd Quarter.

Table 1 shows the data on the frequency and distribution percentage of the numeracy skills of the participants in terms of pictograph without a scale.

Table 1 Frequency and percentage distribution of the numeracy skills of the participants in terms of pictograph without a scale

Learning Competencies	**f**	**%**	**VD**	**I**
Unsa nga insekto ang duha ra ka buok?		27	90	VS	G
Unsa nga klase nga insekto ang pinakadaghan?		26	87	VS	G
Pila ka buok ang mga kaka/lawa?		25	83	S	MG
E-tally pila ang gunting nga anaa sa kahon.		24	80	S	MG
Pila kabuok ang mga salindanaw?		24	80	S	MG
E-tally pila ang lapis nga anaa sa kahon.		24	80	S	MG
E -tally pila ang bag nga anaa sa kahon		23	77	FS	P
Bahin sa unsa ang hulagway?		20	66	DME	NI

Legend: 100(8)-Outstanding-VeryGood;90-95(6-7)-VerySatisfactory-Good;80-85(4-5)-Satisfactory- ModeratelyGood;73-75(2-3)-FairlySatisfactory-Poor;70 (1)-Did not meet expectation- Needs improvement

Table 1 shows the data on the frequency and distribution percentage of the numeracy skills of the participants in terms of pictographs without a scale. Data revealed the following frequency and distribution percentage; the question “Unsa nga insekto ang duha ra ka book?” obtained the highest percentage of 90%, which was verbally described as *Very Satisfactory* and interpreted as *Good*. Learners got a high percentage on this question since it only requires basic counting, typically one of the first numeracy skills taught in early grades. This finding supports the study findings of Lavador et al. (2024), which showed that learners' performance in early numeracy was approaching proficiency levels, emphasizing the need for continued efforts to strengthen basic counting skills in early education.

Question “Bahin sa unsa ang hulagway?” showed the lowest percentage of 66%, which was verbally described as Did not meet expectations and interpreted as Needs Improvement. This indicates that learners lack comprehension or understanding of what they have read. They might be overwhelmed by what they have seen since learners are visual learners, become fascinated by the illustrations, and tend to forget what the picture says. This finding supports the study findings of Rosen and Zaman (2021), which showed that the application of pictographs plays a vital role in developing foundational data literacy skills within primary education. This intuitively introduces counting, comparison, and proportion, but most learners find it difficult without prior and basic knowledge of these three skills. Additionally, Mafikoyumi et al. (2022) found certain limitations with pictographs since learners’ abilities to correctly interpret pictographs develop over time.

Table 2 presents the extent of numeracy skills manifested by Grade 1 learners in the summative test along with the learning competencies in the 3rd Quarter regarding subtraction of numbers where numbers are less than 100.

Table 2 Frequency and percentage distribution of the numeracy skills of the participants in terms of subtraction of numbers less than 100

Learning Competencies	f	%	VD	I
Pila ka saging ang nabilin kon gikan-an kini?	26	87	S	MD
Pagkuha / Subtraction: 67- 7=?	26	87	S	MD
Pila ka mansanas ang nabilin?	25	83	FS	P
5+5=n - Unsa ang n sa addition sentence?	25	83	FS	P
8-n= 4- Unsa ang n sa subtraction sentence?	25	83	FS	P
Unsa ang pangutana sa problema?	26	87	S	MD
Unsa ang paagi o operasyon nga gamiton?	24	80	FS	P
Pagkuha / Subtraction: 26- 5=__?	24	80	FS	*P*
Unsa ang katumbas sa 9-5=__?	23	77	U	VP
Pagkuha / Subtraction: 35- 4=?	23	77	U	VP
Pagkuha / Subtraction: 28- 15=?	20	67	DME	NI
Pagkuha / Subtraction: 89- 26=?	15	60	DME	NI
Unsa ang katumbas sa 7+5=__?	17	57	DME	NI
Unsa ang gihatag nga datos?	17	57	DME	NI
Unsa ang hustong numerong hugpulong?	18	56	DME	NI
Pagkuha / Subtraction: 98- 65=?	18	56	DME	NI
Expanded form: 28-12=?	15	47	DME	NI
Expanded form: 75-60=?	12	38	DME	NI

*Legend:*96-100(16-18)-Outstanding-VeryGood;91-95(13-15)-VerySatisfactory-Good;85-90(10-12)-Satisfactory- ModeratelyGood;79-84(7-9)-Fairlysatisfactory-Poor;75-78(1)-Unsatisfactory-VeryPoor;70-7491-3)Did not meet the expectation- Needs Improvement

As shown in Table 2 the frequency and percentage distribution of numeracy skills related to subtracting numbers less than 100. The first and second questions obtained the highest percentage of 87%, which was verbally described as *Satisfactory* and interpreted as *Moderately good.* Most learners nowadays know how to do basic mathematical equations presented straightforwardly, such as giving concrete representations like pictures and objects. This finding supports the study findings of Moyer-Packenham and Westenskow (2020). The effectiveness of using both virtual and physical manipulatives to teach subtraction denotes an impact on learners' engagement and comprehension of subtraction. Monte (2021) also emphasizes manipulatives at an early stage, which makes subtraction more engaging and allows learners to explore problem-solving strategies in a supportive and interactive manner.

Meanwhile, most learners struggled the most and needed to get correct answers with expanded forms that had the range of 38%-47% labeled as the lowest percentage among other questions. Data revealed that these questions were verbally described as not meeting expectations and interpreted as needing improvement. The struggle can be seen in that learners have not yet developed a strong conceptual grasp of place value, making it hard to manipulate numbers this way. The finding supports the study findings of Aunola et al. (2024) that early identification and support for children with lower math proficiency help bridge gaps and promote equitable learning opportunities. The study of Lopez et al., 2022 & Flores et al., 2022) shows that early numeracy skills are important for later literacy achievement. An example is the evidence that children's numeracy learning profiles depend on the learning context and the teaching practices used in the classroom.

Table 3 presents the extent of numeracy skills manifested by Grade 1 learners in the summative test along with the learning competencies in the 3rd Quarter in terms of repeating patterns.

Table 3 Frequency and percentage distribution of the numeracy skills of the participants in terms of repeating patterns

Learning Competencies	f	%	VD	I
Paghimo og kaugalingong pattern.	26	81	S	MD

Paghimo og kaugalingong pattern.	26	81	S	MD
Unsa ang musunod nga letra sa alpabeto?	24	80	S	MD
Unsa ang musunod nga butang base sa pagkaplastar niini?	24	80	S	MD

Legend: 90-100(4)-Oustanding-VeryGood;85-89(3)-Very Satisfactory Good;80-84(2)-Satisfactory-ModeratelyGood; 75-79(1)-Unsatisfactory-Poor;70-74(0) Did not meet the expectation-Needs Improvement

This table shows the frequency and percentage distribution of Grade 1 learners' numeracy skills in the area of repeating patterns. The frequency (f) values for all four items reflected percentages ranging from 80% to 81%, which are verbally described as *Satisfactory* and interpreted as *Moderately Good*. These results suggest that most learners could recognize and extend repeating patterns with consistent competency. This finding aligns with the study by Junker et al. (2024), which emphasized the value of unit-isolating activities in enhancing elementary mathematics education, particularly in the context of repeating patterns. Similarly, Luken and Sauzet (2021) advocated using scaffolding strategies to help learners identify the repeating unit more effectively. Their research also underscored the importance of examining learners' reasoning behind their pattern recognition and extension choices to deepen understanding.

IV. CONCLUSIONS AND RECOMMENDATIONS

The least learned competencies based on the learning competencies of Grade 1 learners in Mathematics for the 3rd quarter of the school year 2024-2025 were as follows: interpreting a pictograph equivalent expression; subtraction in a word problem; subtraction of 2- 2-digit numbers in 1-100 numbers; and subtraction in expanded form. The numeracy skills manifested by Grade 1 learners through the least learned competencies, resulting in the design and development of the numeracy workbook that contained a selection of topics on pictograph without a scale, equivalent expression, subtraction in a word problem, subtraction of 2 -digit numbers in 1-100 numbers and subtraction in an expanded form aimed to enhance the numeracy skills of the learners. The use of the numeracy workbook may enhance and motivate the learners' appreciation of data representation, subtraction, and patterns to rise with higher standards of numerate skills. Teachers are encouraged to use this workbook, which may enhance the learners' proficiency in basic number operations, boosting their academic performance. Future researchers may conduct a study to verify the effectiveness of using the numeracy workbook, which will guide the continuous improvement of the material.

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