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Development and Validation of Instructional Skill Book in Grade 1 Mathematics

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Abstract :

Mastery of early numeracy skills is essential for progressing to higher-order mathematical thinking. To excel in Mathematics, learners must demonstrate proficiency in number sense, pattern recognition, and problem-solving. These competencies form the cornerstone of mathematical understanding and are vital for fostering students' ability to analyze and think critically. This study dealt with the development and validation of instructional skill book in grade 1 Mathematics in Lupi District, Camarines Sur, school year 2022-2023. It determined the following: 1) proficiency level of grade 1 learners in Mathematics along number sense, number seriation, and problem solving; 2) significant differences in numeracy level among learning areas and among learning groups; 3) design of the developed skill book for grade 1 learners in Mathematics along expected learning outcomes, learning content, and learning activities; 4) curricular validity of the skill book in terms of alignment of curriculum objectives, meeting individual needs, and diversity of drills/ exercise for learning activities; and 5) implication to educational management. The result of the study would be a great help to the grade 1 learners, teachers, and curriculum makers to consider the use of supplementary materials in enhancing learners' numeracy skills that will encourage and motivate learners to learn more and develop their skills along number sense, number seriation, and problem solving.

Keywords: numeracy skills, instructionl skill book, development and validation

I. INTRODUCTION

Children enters elementary school with different levels of Mathematics skills. Some children have a good understanding of basic number concepts, while others struggle with simple tasks like counting, recognizing numbers, understanding symbols, comparing quantities, and grasping addition and subtraction. These early Mathematics skills are often called number sense or early numeracy skills. It is important for students to learn and understand these skills before moving on to more difficult Mathematics problems. This article explains key early Mathematics skills and provides ways to teach these skills to students who have trouble with Mathematics.

Result from the 2019 Trends in International Mathematics and Science Study (TIMMS), the Philippines scored 297 in Mathematics interpreted as "significantly lower" compared to other participating countries and ranked lowest among 58 countries. This is an alarming indicator of children's loss of interest in Mathematics as they moved further in the academic ladder. Learning Mathematics can be a challenging journey for students, regardless of their learning pace. Slow learners may face difficulties understanding complex concepts, leading to frustration and lack of confidence. For instance, slow learner might struggle with grasping the concept of fraction, finding it difficult to visualize and apply them to real-world scenarios. Average Learners, while not experiencing the same level of difficulty as slow learners, may still encounter challenges in certain areas, such as problem-solving and algebraic equations. For example, an average learner might find it difficult to choose the correct formula to use when solving a geometry problem. Fast learners, on the other hand, may become bored and disengaged if they are not challenged. They might find the pace of the class too slow or the material too easy, leading to a loss of motivation.

The Early Language, Literacy, and Numeracy Program (ELLNP), as outlined in DepEd Order No. 18, s. 2017, aligns closely with Sustainable Development Goal 4 (SDG 4) by promoting inclusive and equitable quality education and fostering lifelong learning opportunities for all. The program emphasizes the development of Filipino children's literacy and numeracy skills from Kindergarten to Grade 3, consistent with the K to 12 Basic Education Curriculum. It also aims to establish a sustainable and cost-effective professional development system for teachers. Aguhayon, et al. (2023) states that a certain supplementary instruction or activity effectively addresses diverse student needs, enhancing achievement by considering individual strengths and differences.

In the current education system, various learning materials are introduced and presented to the learners to address their needs in enhancing their numeracy skills. Though teachers presented different kinds and new trends of teaching strategies in developing numeracy skills of pupils, results from the post-test and periodical tests still show that pupils in the primary grade level have difficulty in understanding and even comprehending some of the learning competencies in Mathematics. Still, there were learners even at the half of the quarter still cannot recognize numbers, finding it hard to remember the number name and number

symbol and the order of numbers. Lastly, learners have difficulty in understanding and performing basic operations as well solving simple problem- solving steps. At present, learners lack proficiency in number relations and in comprehending problem solving. With this deficiency, it is difficult to bring them up to the next level of skill to be mastered included in the most essential learning competencies of the department. These situations ignited the eagerness of the researcher to craft an instructional material as its goal that will benefit the diverse learners in developing their numeracy skill as an emerging learner in Mathematics.

II. DEVELOPMENT AND VALIDATION OF INSTRUCTIONAL SKILL BOOK

The National Adoption and Implementation of the Philippine Professional Standards for Teachers (DepEd Order no. 42 S. 2017), asserted that teachers must apply a variety of assessment tools and strategies in monitoring, evaluating, documenting and reporting learners' needs, progress and achievement.

Apparently, Mercader, et al. (2017) the differences in acquisition of skills in the initial learning of Mathematics influence school and life success, wherein it was found out that the first schooling years are fundamental to build and strengthen the base of knowledge and skills for the correct development of the different learning areas in the mathematical field (Mercader, et al., 2017). On the other hand, teacher-made instructional materials are resources intentionally created by teachers or collaboratively with pupils to enhance meaningful teaching and learning in the classroom, Igbo (2014), as cited by Yeboah (2019).

Ramos (2016) determined the effectiveness of instructional materials that will boost the development of the skills needed by the students is helpful for the attainment of the competency level the curriculum wanted to achieve in every learner. that the material provides learning experiences with higher achievement for students. Students who were taught modular learning and other supplementary skill book techniques were encouraged to explore the relationship with ideas on their own and relate these and able to form number of branches (Charles, et al., 2018).

The study of Christensen, et al. (2020) found that most students viewed the workbook as a valuable tool for effectively applying knowledge and skills. The workbook played a key role in helping students achieve their content objectives and develop the skills they were taught. Hence, Linde, et al. (2023), emphasized on developing students' mathematcal skills aligned seamlessly with the objective of enhancing numeracy skills through the creation of a skill book in Mathematics. Specifically, the study highlighted the importance of providing teachers with supplementary materials and methodological support to successfully integrate transversal skill development into their teaching practices. Connecting to the recent study, the development of a skill book for Mathematics can contribute to a more robust and well-rounded approach to numeracy skill enhancement in educational settings.

III. NUMERACY SKILLS

If Filipino learners have strong foundation and mastery in Mathematics, they can deal well much higher learning competencies as they continue to progress in there. As such, to have a pedagogical effect of having content and skills necessary for improving numeracy skills both for self-learning and in the classroom, a stimulating interest of pupils in learning numeracy skills should be developed. This has demonstrated that designing an instructional approach will help provide a stimulating interest of pupils in learning and improving numeracy skills. The development of foundational early number skills is an important aspect of early mathematics instruction. Ridwan (2023) emphasized the significant influence of students' self-efficacy on their numeracy skills, which, in turn, impacts their success in participating actively in classroom learning. High self-efficacy students tend to exhibit more active engagement in learning activities and demonstrate proficiency in numeracy and literacy skills across various indicators, including problem understanding, modeling, concept application, and interpretation.

In line with this, the poor numeracy level on Mathematics performance of the pupils indicates that pupils did not learn fully in the traditional teaching methods employed by the mathematics teachers. Litkowski, et al. (2019) emphasized the crucial developmental phase of children's mathematics skills. Their findings highlighted a potential gap in opportunities for engaging in mathematics within elementary classrooms, with activities and instruction frequently falling below the skill levels of the children.

Likewise, the study of Surya, et al. (2017) found out that the current educational system transpire to the Filipino classroom as the teacher should connect mathematical ideas to the students, so that the students' understanding of the problem solving will be a skill they develop. Use of models and strategies in teaching was one of the opportunities the study suggested for the improvement of the students' mathematical skills.

The study by Clements and Sarama as cited by Westaway, et al. (2023), highlighted the holistic perspective on numerical cognition and the development of learning trajectories aligns with the foundational aspects of number sense, emphasizing a deeper comprehension of mathematical skills and concepts.

I. RESEARCH METHODOLOGY

The study utilized descriptive-comparative and Research and Development method. It involved 100 grade 1 pupils and 10 teacher-validators. Data gathering tools used were teacher-made test and evaluation sheet. Statistical tools utilized were mean, standard deviation, proficiency level, weighted mean, and one-way analysis of variance.

3.1Population and Sample

The respondents of the study were the Grade 1 learners of the four (4) Elementary Schools in Lupi District for the school year 2022-2023. Selected grade 1 learner from the selected schools were included in the study using quota sampling technique. Moreover, Quota sampling was used in the study to ensure that the sample of Grade 1 learners from Lupi District for the school year 2022-2023 accurately represented the diverse geographic location of the school such as: (a) mountainous and upland, (b) lowland, (c) coastal area, and (d) roadside.

3.2 Data and Sources of Data

This research utilized the Descriptive-Comparative and Research and Development method of research. Descriptive method was used in determining the proficiency level in numeracy of grade 1 learners and the level of validity of the Instruction Skill Book in improving numeracy skills. Additionally, the Comparative method facilitated a comparative analysis, with regards to significant differences of the numeracy skill among learning areas and among learning groups.

Research and Development (R&D) was used in developing the Skill Book for Grade 1. This process was considered appropriate since the study focused on the instructional skill book development. Research and Development comprised of systematic work in order to increase knowledge and to device new product which is the skill book.

3.3 Theoretical framework

This study is anchored on the following theories: Bruner's Theory of Learning (McLeod, 2019) as the main theory; supported by the Spiro's Cognitive Flexibility Theory (Pappas, 2015), Gagne's Event of Instruction (Mahama, 2023), and Vygotsky's Scaffolding Theory (Wu, 2017).

Bruners' theory of Learning as cited by McLeod (2018) states that the outcome of cognitive development is thinking. Thus, children as they grow must acquire a way of representing the "recurrent regularities" in their environment. In Bruner's theory, it is important that outcomes of learning include not just the concepts, categories, and problem-solving procedures invented previously by the culture, but also the ability to "invent" these things for oneself. Moreover, the concept of discovery learning implies that students construct their own knowledge for themselves. The role of the teacher should not be to teach information by rote learning, but instead to facilitate the learning process. This means that a good teacher will design lessons that help students discover the relationship between bits of information.

On the other hand, the Cognitive Flexibility Theory of Spiro focused on the nature of learning in complex and ill-structured domains. This theory stated that, through cognitive flexibility, the students are able to spontaneously restructure his/her knowledge, in many ways, in adaptive response to radically changing situational demands. Moreover, this theory imply that it is a function of both the way knowledge is represented and the processes that operate on those mental representations (e.g., processes of schema assembly rather than intact schema retrieval).

In addition, Spiro's theory was largely focused on the transfer of knowledge and skills beyond their initial learning situation. For this reason, emphasis is placed upon the presentation of information from multiple perspectives and uses many case studies that present diverse examples. The theory also asserts that effective learning is context-dependent, so instruction needs to be very specific. With this regard, the theory stresses the importance of constructed knowledge; learners must be given an opportunity to develop their own representations of information to properly learn.

Gagne's Events of Instruction as cited by Mahama, (2023) emphasizes the structured design of activities to optimize learning outcomes. This approach involves selecting appropriate instructional events, developing a cohesive format, and executing them sequentially. In the context of developing and validating an instructional skill book for grade 1 Mathematics, these principles are crucial. By adhering to Gagne's model, each lesson can be meticulously crafted to include stages like gaining attention, presenting content, providing guidance, eliciting performance, offering feedback, and assessing learning, fostering a well-rounded educational experience. This structured approach not only enhances classroom education across disciplines but also cultivates enhanced critical thinking abilities among students, aligning with the broader goals of educational development. Thus, integrating Gagne's Events of Instruction into the design of the instructional skill book ensures it effectively supports grade 1 mathematics education through methodical and engaging learning experiences.

3.4Statistical tools

To answer specific problem of the study, the following statistical tools were utilized:

3.4.1 Mean

This has been used to determine the performance level of the students in the test along respective aspects.

3.4.2 Standard Deviation

This tool was used to determine degree of dispersion among scores.

3.4.2.1 Proficiency Level

This tool was utilized to determine the competency level of learners.

3.4.2.2 Weighted Mean

This was utilized to determine the validity of the skill book.

IV. RESULTS AND DISCUSSION

Students among the three learning groups were still developing and had low mastery level in the three-numeracy skill along number sense, number seriation and problem solving (Table 1). The comparison of the performance within the group underscored the importance of recognizing and addressing the specific learning needs within each group. While slow learners and average learners demonstrated a more consistent level of performance, fast learners exhibited varying degrees of understanding, emphasizing the necessity for tailored interventions to enhance overall proficiency in number sense across all learning groups.

In Table 2A to Table 2D showed that the differences among the learning areas along numeracy skills and among learning group was significant. The differences of numeracy skills by learning areas in the mathematics were different. The comparison of numeracy level among learning areas, found a significant difference in numeracy levels between problem-solving and number sense, the difference between number sense and number seriation was not significant within the context of this study. More so, the Significant Differences in Numeracy Skills among Learning Area were not significant among groups of learners. However, data (Table 2D) showed that there were no significant differences in problem solving skills among the three groups of learners which indicates that their ability to apply numerical concepts to solve problem did not differ significantly.

According to the Cognitive Flexibility Theory, as discussed by Spiro and cited in Pappas (2017), learners with higher cognitive flexibility are better equipped to reorganize their knowledge dynamically, enabling greater adaptability and proficiency in these numeracy domains. This underscored the importance of fostering cognitive flexibility to support diverse and evolving mathematical learning needs. The assessment results suggest that these learners struggled, particularly with answering simple problem-solving questions. Results presented in the table implied that there were no significant differences in number sense among the three groups of learners. This suggests that their abilities in understanding and manipulating numbers were the same.

Hence, the differences in numeracy skills among learning groups result was supported by the study of Dela Cruz (2019) which implied that diversity of learners and learning styles hinders the development of skills specifically numeracy skill of the learners. From the findings of the study, it was revealed that there was a significant positive impact of the use of various supplementary material to address the differences in numeracy skills of the students.

The findings indicate that the skill book effectively incorporated differentiated instruction, tailored to meet the needs of various learning groups. This comprehensive approach ensured that diverse learners are supported in achieving their educational goals. As shown in tables 3A to 3C. The curricular validity of the skill book revealed positive outcomes along alignment of curriculum objectives, meeting individual needs, and for the diversity of drills/exercises in learning activities.

This implied that the skill book had furnished the use of appropriate media to help learners understand every differentiated activity assigned to them; likewise, the activities complement the needs of those who belong to specific learning groups. By providing tailored resources and activities, the skill book enhances engagement and fosters a deeper understanding of the material. Ultimately, this approach supports a more effective learning experience that caters to diverse student needs.

Figures and Tables

Figure 1. This paradigm shows the theories that support the teaching approaches in improving numeracy skills.

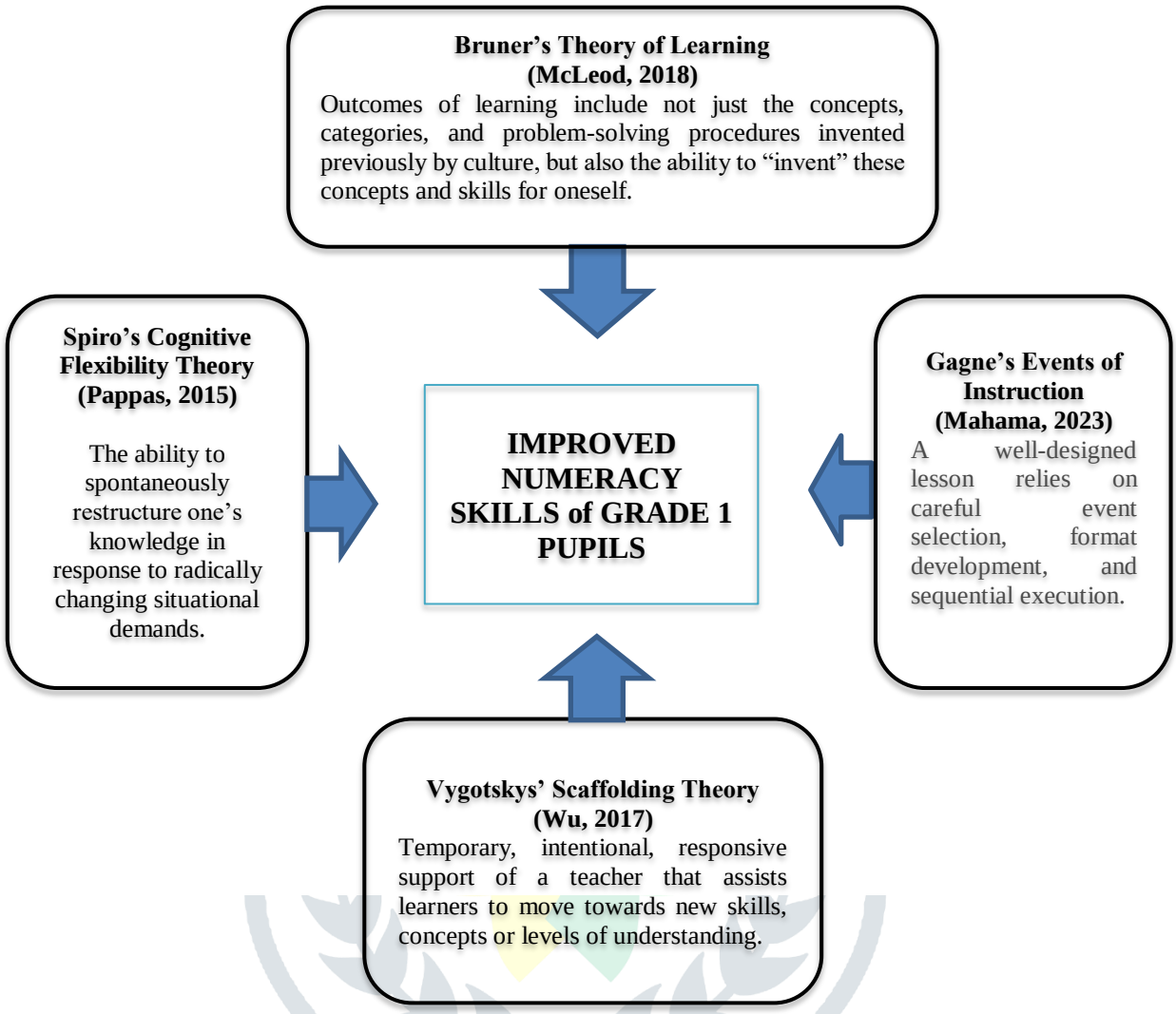

Table 1. Proficiency Level in Numeracy of Grade 1

Competency	Learning Group	Mean	SD	PL	Interpretation
Number Sense	Slow	3.11	2.52	31.10	Beginning
	Average	2.76	2.30	27.6	Beginning
	Fast	4.21	3.07	42.10	Beginning
Number Seriation	Slow	2.57	2.10	25.70	Beginning
	Average	1.92	1.55	19.2	Beginning
	Fast	3.71	1.72	37.10	Beginning
Problem Solving	Slow	2.11	1.31	21.10	Beginning
	Average	1.95	1.53	19.5	Beginning
	Fast	2.25	1.46	22.50	Beginning

Legend: DepEd Order No. 8 s. 2015

Performance Level	***Proficiency Level***
90-100	*Advance (A)*
85-89	*Proficient (P)*
80-84	*Approaching Proficiency (AP)*
75-79	*Developing (D)*
Below 75	*Beginning (B)*

Table 2A. Differences in Numeracy Level by Learning Area

	Sum of Squares	Mean Square	F	P-value	Interpretation
Between Groups	76.907	38.453	8.936	.000	Significant
Within Groups	1278.090	4.303			
Total	1354.997				

Table 2B. Comparison of Numeracy Level among Learning Areas

Learning Area		Mean Difference	P-value	Interpretation
Number Sense	Number Seriation	0.64	.094	Not Significant
	Problem Solving	1.24	.000	Significant
Number Seriation	Problem solving	0.60	.125	Not Significant

$p \leq 0.05\ (Significant); p\ > 0.05\ (Not\ Significant)$

Table 2C. Significant Differences in Numeracy Skills among Learning Areas

Learning Area		Sum of Squares	Mean Square	F	P-Value	Int.
Number sense	Between Groups	35.522	17.761	2.606	.079	Not Significant
	Within Groups	661.068	6.815			
	Total	696.590				
Number seriation	Between Groups	51.708	25.854	7.910	.001	Significant
	Within Groups	317.042	3.268			
	Total	368.750				
Problem solving	Between Groups	1.608	0.804	0.369	.692	Not Significant
	Within Groups	211.142	2.177			
	Total	212.750				

Table 2D. Significant Differences in Numeracy Skill among Learning Groups

Learning Area	Learners		Mean Difference	P-value	Int
Number Sense	Slow Learner	Average learners	0.36	.845	NS
		fast learners	1.10	.256	NS
	Average learners	Fast learners	1.46	.089	NS
Number Seriation	Slow Learner	Average learners	0.65	.314	NS
		fast learners	1.14	.049	S
	Average learners	Fast learners	1.80	.001	S
Problem Solving	Slow Learner	Average learners	0.05	.988	NS
		fast learners	0.25	.800	NS
	Average learners	Fast learners	0.30	.714	NS

S-significant NS- Not Significant

Table 3. Curricular Validity of the Skill Book along Alignment of Curriculum Objectives

Indicators	WM	Int	Rank
Activities are congruent with the learning objectives	4.00	VG	2.5
The skill book provided assessment strategies that are aligned with the lesson objectives.	4.00	VG	2.5
The skill book is relatively important in classroom discussion and enhancement of numeracy skills	4.00	VG	2.5
Activities in the skill book are attainable in congruence to the most essential learning competencies.	4.00	VG	2.5
Learning objectives are appropriately sub-tasked for the lesson.	3.80	VG	5
AWM	**3.96**	**VG**	

Legend:

3.26-4.00	Very Good
2.51-3.25	Good
1.76-2.50	Fair
1.00-1.75	Poor

Table 3A. Curricular Validity of the Skill Book along Meeting Individual Needs

Indicators	WM	Int	Rank
The skill book uses vocabulary that are within the learner's level of competence in the language used.	4.00	VG	1.5
The skill book is relevant to the needs of the pupils.	4.00	VG	1.5
The skill book presents differentiated instruction that will help learners obtain the needed learning skills.	3.90	VG	3
The number of activities in the skill book are "just enough" and appropriate to meet the individual learning needs of learners.	3.80	VG	4
The skill book provides an activity, task or complementary material that will enhance the learner's understanding of concepts.	3.70	VG	5
AWM	**3.88**	**VG**	

Table 3B. Curricular Validity of the Skill Book along Diversity of Drills

Indicators	WM	Int	Rank
The skill book provides an activity, task or complementary material that will enhance the learner's understanding of concepts.	4.00	VG	1.5
The skill book uses vocabulary that are within the learner's level of competence in the language used.	4.00	VG	1.5
The number of activities in the skill book are "just enough" and appropriate to meet the individual learning needs of learners.	3.90	VG	3.5
The skill book presents differentiated instruction that will help learners obtain the needed learning skills.	3.90	VG	3.5
The skill book is relevant to the needs of the pupils.	3.60	VG	5
AWM	**3.88**	**VG**	

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