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The use of project BIBO in improving the numeracy rate of elementary schools in Candelaria East District

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Abstract

This study focused on improving the numeracy rate of the various elementary schools in Candelaria East District in the division of Quezon, Philippines through the implementation of Project BIBO (Bridging Imperfections in Basic Operations). Addressing the gap of the learners who are not fully capitalizing on the basic arithmetic and fundamental operations can be done by implementing various numeracy interventions. A descriptive research design was utilized in analyzing the numeracy rates of the participating elementary schools before and after the conduct of Project BIBO. Samples were randomly selected while descriptive statistics and tests of difference were used in analyzing and interpreting the data. After a one-year implementation of the said project, results showed a pre-numeracy rate of 85.54% with a standard deviation of 0.108 and a post-numeracy rate of 94.46 with a standard deviation of 0.032. A t-value of -3.592 and a p-value of 0.003 provided sufficient evidence to conclude at 0.05 level of significance that there is a significant difference between the pre-numeracy and post-numeracy rates. It is therefore reflected from the results that the implementation of Project BIBO has successfully improved the numeracy rating of the various elementary schools in Candelaria East District, and thus, the continuous implementation of the project is hereby recommended as future actions within the wider range of scope in the district level.

Keywords: *numeracy, numeracy rate, basic operations, elementary schools, mathematics, Philippines*

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1. Introduction

The Programme for the International Assessment of Adult Competencies (PIAAC) outlined numeracy as the capacity to comprehend, apply, decipher, and convey mathematical concepts and information, enabling individuals to effectively navigate various mathematical challenges encountered in adult life. Additionally, numeracy encompasses the aptitude, competencies, attitudes, and tendencies necessary for individuals to apply mathematical principles across diverse scenarios. This entails acknowledging and comprehending the significance of mathematics in real-world contexts, along with possessing the motivation and ability to utilize mathematical knowledge and skills with intentionality (Curry, 2019).

Number, measurement and geometry, statistics, and probability are common aspects of most people's mathematical experience in everyday personal, study, and work situations. Similarly, crucial are the indispensable functions of algebra, functions, relations, logic, mathematical structures, and the process of working mathematically in shaping people's comprehension of both the natural and human realms, as well as the interconnectedness between them (Yinnar Primary School, n.d.).

In Candelaria East District in the Philippines, the outcomes of previous numeracy tests have revealed a concerning lack of proficiency among learners in utilizing and applying fundamental mathematical operations like addition, subtraction, multiplication, and division. These operations are undeniably integral to everyday activities. Therefore, the objective is to enhance the numeracy skills of all learners, providing them with essential tools for navigating daily life. The anticipated outcomes of this initiative encompass a higher numeracy proficiency among elementary school students in Candelaria East District, along with the ongoing implementation of interventions aimed at benefiting every learner's mathematical understanding within the district. To enhance numeracy skills among its learners, Candelaria East District has initiated several programs and interventions aimed at reducing non-numerate learners. The flagship initiative, Project BIBO (Bridging Imperfections in Basic Operations), complements other endeavors such as Project BLAZE (Bridging Learners Authentic Zeal of Excellence) and Project GLOW (Getting Learning Outcomes Worthwhile). Project BIBO encompasses a range of interventions focusing on basic operations across all elementary school levels. These interventions aim to elevate the numeracy rate by assessing individual learners' performance through pretest and posttest.

The expected results of this project include an increased numeracy rate of elementary schools of Candelaria East District, as well as continuous conduct of such interventions that will benefit every Mathematics learner in the district. Hence, this study aimed to determine the impact of Project BIBO on the numeracy rate of elementary schools in Candelaria East District. At 0.05 level of significance, this study posits that:

HO1: There is no significant difference between the numeracy rates of the participating schools before and after the implementation of Project BIBO

2. Literature review

2.1. Numeracy Skills

Numeracy involves grasping numbers, performing calculations, solving numerical problems, gauging measurements, approximating values, categorizing, recognizing patterns, and performing arithmetic operations, among other skills. Both children and adults rely on numeracy and mathematical proficiency to engage in routine tasks such as problem-solving when estimating the time required for walking to school; interpreting data when calculating the required grades for someone to maintain his scholarship; recognizing patterns like when predicting the next house number on a street; and making decisions like when determining the amount of money to be spent and saved. Everyday experiences offer abundant learning opportunities for children, serving as the groundwork for developing numeracy skills (Susperreguy et al., 2020).

A review of literature conducted by Guhl (2019) delves into the influence of acquiring early math and numeracy skills prior to formal education on subsequent academic attainment. While much emphasis in early childhood education centers on literacy, this literature review demonstrates that early math skills wield greater predictive power over academic success throughout elementary schooling. Numerous studies have investigated the importance of these skills in shaping future mathematical proficiency, contributing to the insights presented in this review. It encompasses the definition and development of early math and numeracy skills in young children, their significance, their impact on later mathematical achievement, and recommended strategies for teaching these skills alongside literacy in early childhood education settings.

In the Philippines, several factors were noted to influence the numeracy skills of young individuals. Generally, these factors can be categorized as family and individual variables. Cheung et al. (2017) found out that children's numeracy interest was linked with their parents' practices and attitudes; while on the contrary, the proficiency of children in numeracy was connected to factors such as their gender, age, socioeconomic background, and literacy skills. These results indicate that various family and individual factors could impact the early development of numeracy in disadvantaged children differently. Furthermore, it is possible to encourage parents to utilize home-based numeracy experiences effectively to enhance their children's numeracy skills.

Other factors affecting the numeracy skills of young learners are the ones discovered by Nalangan (2019). She found out that Grade IV students experience moderate impacts from issues related to home life, personal challenges, emotional difficulties, and instructional concerns from teachers and then suggested that remedial teaching sessions could be arranged for students who struggle with mathematics. These results align with the findings of Segers et al. (2015), who discovered that the home numeracy environment was a significant predictor of early numeracy skills, even after accounting for child-related factors and the home literacy environment. The home numeracy environment emerges as a distinctive factor within the home setting that influences numeracy outcomes. In another study by Benavides-Varela et al. (2016), findings revealed that the quantity of numerical knowledge obtained at home emerged as a significant predictor of the participants' proficiency in solving everyday numerical problems and accurately representing numbers, even after factoring in variables such as age, working memory capacity, and the socio-economic and educational background of the family. Furthermore, certain activities, like board games, exhibited associations with children's ability to count, which forms the basis of arithmetic skills. Importantly, assessments reliant on approximate representations were not influenced by the numerical knowledge accumulated at home. This study lends support to assertions concerning the significance and character of home experiences in shaping a child's mathematical development.

2.2. Difficulties in Mathematics

Numerical skills include the four basic arithmetic operations. Focusing on this, several studies were also conducted to discuss and analyze the learners' difficulty to perform addition, subtraction, multiplication and division with natural numbers. Brandt et al. (2016) cited Felicio and Policarpo (2015), who discovered that integrating games into classroom instruction serves as a pedagogical tool enabling students to cultivate problem-solving approaches with whole numbers.

This approach fosters creativity and active engagement among students, as winning necessitates the utilization of strategies that refine the components of logical reasoning. Prieto (2016) highlighted that addition and subtraction operations involving natural numbers often pose challenges for students, especially when borrowing or carrying is involved. The author asserts that these operations are often taught merely as procedures to be memorized, akin to teaching algorithms, rather than ensuring a deep understanding of the underlying concepts of addition and subtraction.

In examining the challenges sixth graders face when solving mathematics word problems involving whole numbers, fractions, and decimals, Kusuma and Renatwati (2018) identified several contributing factors. These include students' struggles with comprehending the wording of the problems, difficulties grasping the concepts underlying fractional operations, limited numeracy skills, and issues with accuracy. Similarly, various studies have tried to answer such difficulties in the fundamental operations. For instance, Mills (2019) discussed observations of three teachers conducting a multiplication lesson, which was part of a series spanning six weeks, aimed at enhancing students' comprehension of the mathematical concepts associated with the interpretation of the multiplication symbol. An analysis of the observations reveals that when the teachers incorporated manipulatives, connected word problems to the children's everyday experiences, and facilitated group discussions, a marked improvement in students' understanding of multiplication was evident.

Ramli et al. (2013) conducted a qualitative investigation into the teaching of mathematics in a secondary school setting in Malaysia. The findings offer insights into various factors that impede students' ability to engage in profound learning of mathematics, including issues such as student discipline, time limitations, and limited exposure to contemporary pedagogical methods. Additionally, the study presents teachers' perspectives on potential pedagogical strategies to address these obstacles and facilitate deep learning in secondary mathematics classrooms. These strategies encompass approaches such as incorporating enjoyable learning experiences, enhancing communication effectiveness, implementing problem-based instruction, embracing constructivist methodologies, integrating real-world applications, utilizing technology, and promoting student-centered learning. According to Febriyanti et al. (2021), teachers employ diverse strategies for identifying and addressing students' learning challenges. Three common methods used by teachers to diagnose difficulties in Mathematics include administering tests, making observations, and conducting interviews. In terms of overcoming these obstacles, teachers implement remedial

measures, offer individual tutoring sessions, allocate additional learning hours for students facing mathematical challenges, and actively engage students in the learning process. The effectiveness of these approaches is evidenced by notable improvements in students' comprehension and academic performance.

2.3. Numeracy interventions

According to the Department of Education (DepEd), the Philippines' disappointing performance in the 2022 Program for International Student Assessment (PISA) signals a significant delay of about five to six years in learning achievements within the country. The Philippines was placed 77th among 81 countries globally in the assessment conducted by the Organization for Economic Cooperation and Development (OECD) for 15-year-old students. The country's scores were approximately 120 points lower than the global average, with specific scores of 355 in mathematics, 347 in reading, and 373 in science (Ines, 2023). This situation calls not just for educators to act but for the entire nation to work collaboratively which led to the development of MATATAG curriculum and the introduction of Catch-up Fridays. As spoken by Vice President and the then DepEd Secretary Sara Duterte, the Philippines' performance in the 2022 PISA "bears uncomfortable truth" and underscore the need for a shared commitment to enhance the country's education system.

Another action that an educator can share for this collective responsibility is the conduct of various intervention activities or programs that can alleviate the learners' poor performance in specific discipline particular in mathematics. The primary objective of intervention classes is to support students in becoming more proficient mathematics learners by enhancing their comprehension of fundamental concepts and bolstering their motivation and self-assurance (Brodesky et al., 2021). Mononen (2014) asserts that instead of allowing children to struggle, interventions in mathematics can effectively enhance the early mathematical abilities of children experiencing difficulties in math, even before they begin formal schooling and during the early grades. Thus, recognizing low math performance and offering adequate assistance should be prioritized as early as in early childhood education.

Mononen et al. (2015) examined the efficacy and identified the educational elements of the mathematics interventions, such as the environment, duration, mathematical content utilized for intervention training and progress assessment, facilitator and professional development support

provided, and characteristics of instructional design. Findings suggested that diverse instructional design features, including explicit teaching, computer-assisted instruction (CAI), gamification, or the application of concrete-representational-abstract levels in mathematical concept representations, contributed to enhancements in mathematical performance. Moreover, a study conducted by Layug et al. (2021) found out the effectiveness of parents and students, one-on-one tutorials, redoing activities with low scores, home visitations, providing supplementary materials and activities, reducing the number of items in activities, and conducting remedial classes as numeracy interventions among grade 7 students in Baguio City National High School. Overall, these interventions were reported to be effective in enhancing students' numeracy skills, bridging the gap between those at risk of failing mathematics and those who are not.

In terms of classroom strategies aimed at enhancing children's numeracy skills, Manalaysay (2021) discovered that consistent utilization of mathematics drills can positively influence the numeracy abilities of students in primary grades. The learners' engagement with mathematics drills, characterized by a causal style of discourse, resulted in notably improved numeracy retention and attainment of mastery over the presented lesson in a single session. This aligns with Luna's (2023) MATHSANAY Numeracy Project, aimed at reducing the numeracy disparity by enhancing skills in four core mathematical operations: addition, subtraction, multiplication, and division. The project targeted 49 Grade 7 students identified as lacking numeracy at Bagbag National High School District in Rosario, Cavite. Results indicated a significant enhancement in numeracy skills among the participants, shifting them from the non-numerate category to moderately numerate. Additionally, Guanzon-Pisaras (2020) conducted a study involving kindergarten students from Odiongan Central School (OCS), Division of Gingoog City, Misamis Oriental. The research revealed that pupils in the experimental group, who utilized mathematics manipulatives, exhibited a higher level of proficiency in numeracy skills compared to those in the control group. The pre-test and post-test scores of both groups showed a noteworthy disparity.

Employing an improved mathematics learning kit, coupled with parental engagement at home, can serve as a successful intervention for enhancing the numeracy abilities of individuals with limited numerical proficiency, particularly in the current context of the new normal. Belleza (2022) conducted research focusing on the numerical aptitude of non-numerate learners using enhanced mathematics learning kits with parental involvement at home. The study observed a

notable enhancement in numeracy skills, transitioning from a low level before the intervention to a high level afterward. Additionally, the results highlighted a substantial disparity between the pretest and posttest mean scores of the non-numerate learners. On the other hand, Magtolis (2023) also observed a notable improvement in numeracy levels after executing Project Renrich, a numeracy intervention initiative targeted at Grade 5 pupils. The discernible enhancement in numeracy skills was evidenced by a rise in the percentage of proficient-level students from 36% to 54%. Moreover, there was a decrease in students categorized as developing, from 46% to 36%, while those classified as beginning declined from 13% to 10%. Notably, the number of non-numerates decreased from 5% to 0%. Through the analysis of the significant difference, it is evident that Project Renrich stands as an efficacious intervention program for enhancing learners' numeracy skills.

2.4. Theoretical framework

This study is anchored on Vygotsky's Socio-Cultural Theory. This theory emphasizes the importance of social interaction and cultural context in cognitive development. It posits that learning occurs within the "zone of proximal development" (ZPD), which is the difference between what a learner can do independently and what they can achieve with guidance and support from a more knowledgeable individual. Vygotsky (1978) as cited by Allman (2020) believed that human development and learning originate in social and cultural interaction. Put differently, individuals' cognitive abilities are influenced by their interactions with others and the cultural environment in which they reside.

In the context of numeracy interventions, Vygotsky's theory suggests that educators can facilitate learning by providing appropriate scaffolding and support tailored to each student's level of understanding. This may involve collaborative problem-solving activities, peer tutoring, and small group discussions where students can learn from one another's perspectives and experiences.

Vygotsky's socio-cultural theory offers a robust theoretical framework for designing and implementing numeracy interventions. This theory emphasizes the significance of social interactions, cultural context, and the role of the more knowledgeable other (MKO) in fostering cognitive development. In the context of numeracy interventions, Vygotsky's theory suggests that learning is not solely an individual endeavor but is deeply intertwined with social interactions and cultural practices (Gowrie NSW, n.d.). Similarly, Vygotsky's concept of the zone of proximal

development (ZPD) is highly relevant to numeracy interventions. The ZPD represents the gap between what a learner can accomplish independently and what they can achieve with appropriate support. Numeracy interventions can be structured to operate within this zone by providing scaffolding and guidance tailored to each student's level of understanding. Educators can employ techniques such as guided problem-solving, peer collaboration, and small group discussions to facilitate learning within the ZPD, thereby promoting students' numerical skills development (Gowrie NSW, n.d.).

Vygotsky's emphasis on the importance of social interactions in learning underscores the value of collaborative learning environments in numeracy interventions. Through collaborative problem-solving activities, peer tutoring, and group discussions, students can engage in meaningful interactions with their peers, share mathematical strategies, and negotiate meaning together. These social interactions not only enhance students' conceptual understanding of numeracy but also promote communication and teamwork skills. Furthermore, Vygotsky's socio-cultural theory highlights the role of cultural tools and artifacts in mediating learning. In the context of numeracy interventions, educators can utilize a variety of instructional materials, such as manipulatives, digital resources, and real-world contexts, to scaffold students' mathematical understanding. By incorporating culturally relevant examples and contexts into numeracy instruction, educators can make mathematical concepts more accessible and meaningful to students from diverse backgrounds.

Overall, Vygotsky's socio-cultural theory provides a comprehensive framework for understanding how social interactions, cultural context, and instructional scaffolding influence learning in numeracy interventions. By leveraging these principles, educators can design effective interventions that promote students' numerical proficiency and mathematical problem-solving skills.

3. Methodology

The participants of the study are the fifteen elementary schools in Candelaria East District, Division of Quezon. The numeracy rates before and after the implementation of Project BIBO were gathered and recorded from the participating elementary schools. These were the submitted

results of each of the participating schools which were tallied and organized by the school head in-charge of Mathematics.

The data-gathering procedure employed consists of the submission of a research proposal to the office of the Public School District Supervisor of Candelaria East District. Once the proposal had been approved and accepted, the researchers proceeded with securing the necessary permit from authorities such as the school heads as well as the mathematics teacher-coordinators of the participating elementary schools. After the permit had been granted, the researchers collected the numeracy rate prior to the implementation of Project BIBO. Project BIBO has been administered to participating schools the whole year round. Then, after the said intervention had been conducted, the researchers again collected the numeracy rate of the participating schools after the implementation of Project BIBO.

The research instruments utilized in this paper include the pre-numeracy and post numeracy tests. These are standardized test provided by the Division of Quezon and are being utilized by every elementary school within the division. The researchers find these tests as the most appropriate test to measure the pre-numeracy and post-numeracy rate of the participating schools since it was believed to eliminate outside factors such as level of difficulty. Various numeracy intervention activities which are generally known in the district as Project BIBO were also conducted and is considered as another research instrument. These intervention activities were validated and approved by every school principal in their own school.

This study utilized the quantitative research method in analyzing the data gathered. After the data collection, tabulation, and organization in Microsoft Excel, data were statistically treated and analyzed. For research questions numbers 1 and 2, the mean and standard deviation were used to describe the data. For research question number 3, paired t-test was used to show if there is a significant difference between the pre-numeracy rate and post-numeracy rate before and after the implementation of Project BIBO.

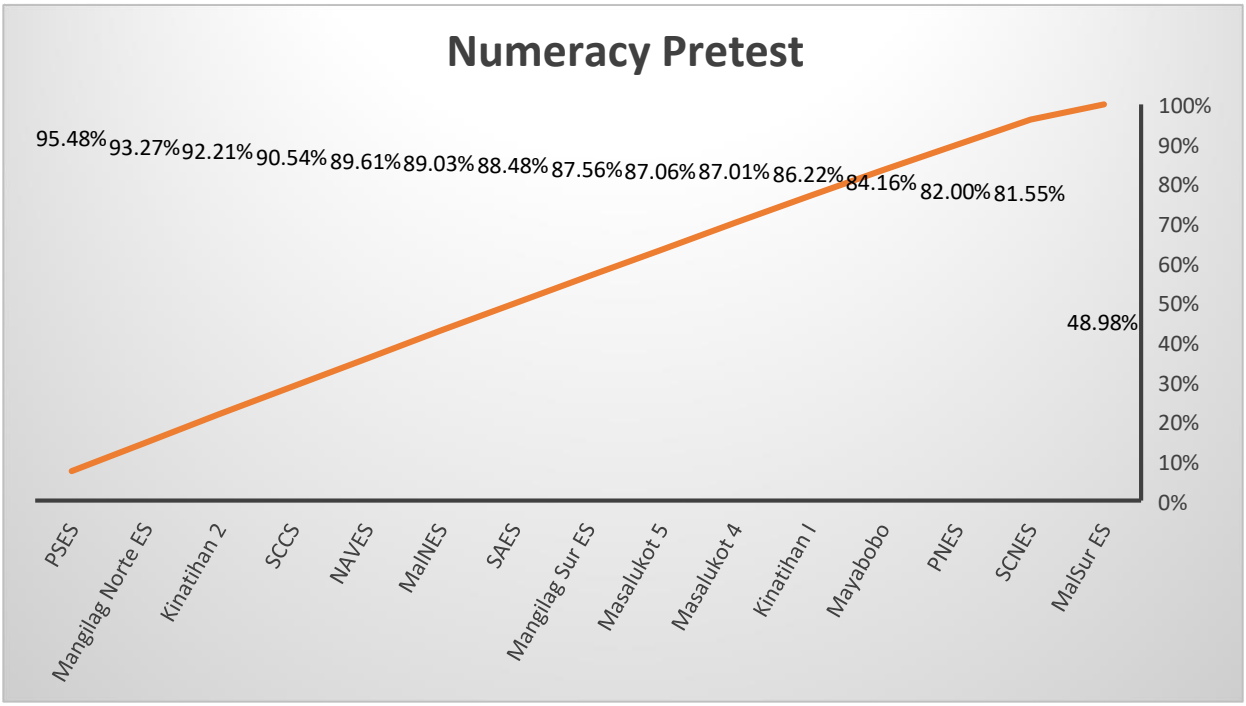
All ethical considerations are well observed in this study. Necessary permits were secured prior to its conduct. Consent to parents and respondents were sought. Anonymity and confidentiality of the respondents were kept and proper citations and referencing were followed.

4. Findings and Discussion

This part discusses the results of the study as well as the researchers' analysis and interpretation of the data gathered and the reflections formulated based on the research outcomes.

Figure 2

Numeracy rate prior to the implementation of Project BIBO



Notes: The figures show the pretest numeracy rate results computed from the 15 participating elementary schools prior to the implementation of the Project BIBO in the district.

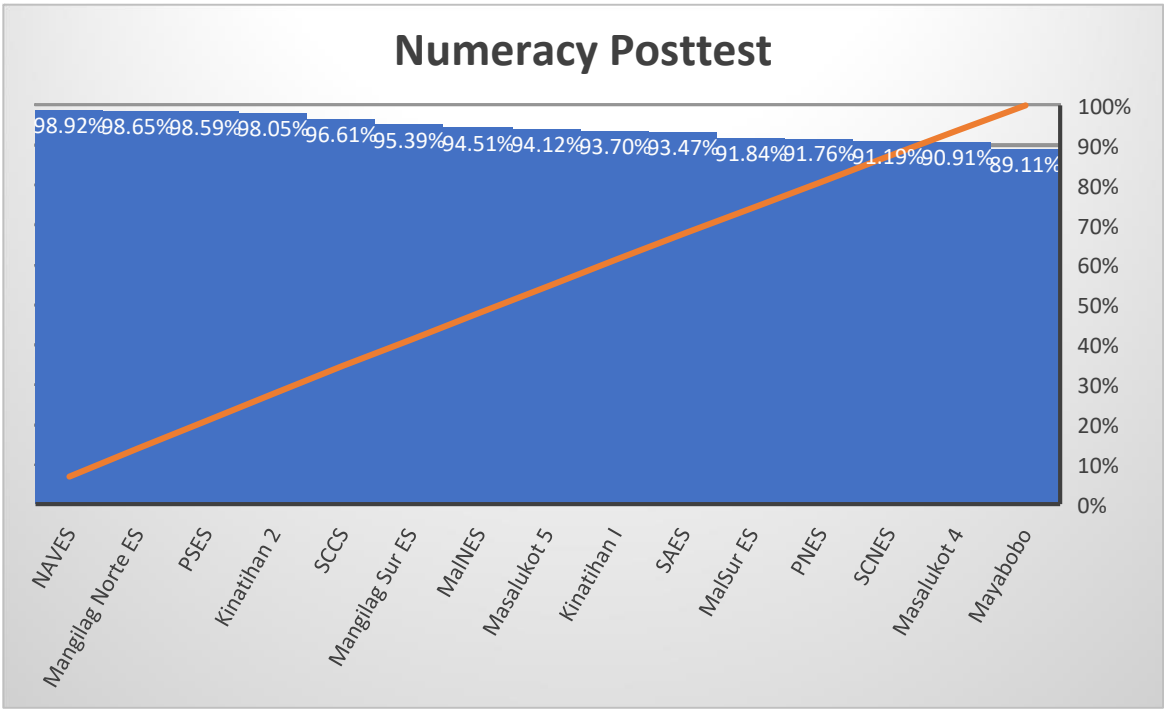
It is shown in figure 2 that the school with the highest numeracy rate in the Numeracy Pretest is Pahinga Sur ES with 95.48% while the school with the lowest numeracy rate is Malabanban Sur ES with 48.98%. The mean numeracy rate of these fifteen elementary schools in the Numeracy Pretest is 85.54% and the standard deviation is 0.108.

This statistic is not particularly concerning in terms of the percentage of proficient students in the area, although Dela Peña's (2023) study emphasized findings from the Southeast Asia Primary Learning Matrix 2019 (SEA-PLM) which showed that only 17 percent of Grade 5 students in the Philippines met the minimum mathematical standard at the end of the primary education as provided in the Sustainable Development Goals (SDGs) 4.1.1 – Education

Proficiency of the United Nation Children's Fund (UNICEF). This percentage results in the local district level, however, still signifies something to be and that can be increased and improved.

Figure 3

Numeracy rate after the implementation of Project BIBO



Notes: This figure shows the posttest numeracy rate results computed from the 15 participating elementary schools after the implementation of the Project BIBO in the district.

It is shown in figure 3 that the school with the highest numeracy rate in the posttest is Nadres and Virtucio ES with 98.92% while the school with the lowest mean is Mayabobo ES with 89.11%. The mean numeracy rate of these fifteen elementary schools in the posttest is 94.46% and the standard deviation is 0.032.

This figure can be indicated as response to the Department of Education's Basic Education Development Plan (BEDP) 2030 intermediate outcomes (IO) under the quality aspect which states that "*Learners complete K-12 basic education having attained all learning standards that equip them with the necessary skills (literacy and numeracy) and attributes to pursue their chosen paths*." The implementation of various numeracy intervention under Project BIBO can be said to

address the needs of ensuring that learners benefit from their completion of key stage 2 of the basic education process.

Table 1

Paired Test of Difference between Pre-Numeracy and Post-Numeracy Rates

		Paired Differences					t	Df	Sig. (2 tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	NUMPRE - 2.48055 NUMPOST	-8.91067	9.60713		-14.23092	-3.59042	-3.592	14	.003

Sig. $\alpha < 0.05$

With a mean difference of -8.911, it indicates that there is an increase from the pretest to posttest. A standard deviation of 9.608 indicates how dispersed the values are from the mean and a standard error of the mean of 2.481 indicates a high precision of the sample mean as to how far it is likely to be from the actual true population mean. A t-value of -3.592 and a p-value of 0.003 shows that there is a significant difference between the numeracy rates based on the pretest and posttest results at 0.05 level of significance. Hence, the research hypothesis stated in the early part of this research is therefore rejected. This result indicates that the implementation of Project BIBO has successfully increased the numeracy rates of the participating schools in the district.

The result was congruent with the study of Layug et al. (2021), which showed that the interventions applied by the teachers such as conference with parents and students, one-on-one tutorial, redo activities with low scores, home visitation, provide supplementary materials and activities, lessen items of activities and remedial class have been highly effective in enhancing the students' numeracy skills and thus believed to close the gap between learners who are likely to fail Mathematics and those who are not. With this, it can be reflected that the various numeracy

interventions under Project BIBO should be continuously implemented to ensure the attainment of the necessary numeracy skills in the Key Stage 2 of the basic education cycle.

5. Conclusion

This study found a relatively high numeracy rate before the implementation of Project BIBO among different elementary schools in Candelaria East District with a rate of 85.54% and a standard deviation of 0.108. There is an increased rate of numeracy after the implementation of Project BIBO among the different elementary schools in Candelaria East District as manifested from its posttest results of 94.46% and a standard deviation of 0.032. hence, there is a significant difference between the pre-numeracy and post numeracy test results with a p-value of 0.003 which is less than 0.05 level of significance. The implementation of Project BIBO has successfully increased the numeracy rate of different elementary schools in Candelaria East District.

This study recommends to intensify the implementation of Project BIBO as an intervention in increasing the numeracy rate of the entire elementary school levels in Candelaria East District. Mathematics teachers are encouraged to develop various numeracy intervention activities as well as intervention materials to ensure learners' active participation.

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