

The Impact of Early Math and Numeracy Skills on Academic Achievement In Elementary School

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Abstract — It has been eight years when the K to 12 Basic Education Curriculum was implemented in the country. During this period, many issues have been raised concerning its overall impact specifically on the mathematical skills of each learner. This study explored on the experiences of teachers on the development of numeracy skills of primary pupils. The focus of this study are the teachers of Jolencio R. Alberca Elementary School located in Tres de Mayo, Digos City. Teachers' experiences on the development of numeracy skills among primary pupils were a smooth flow of instruction in Mathematics, enhanced engagement to instruction showing confidence, interest and enjoyment on the lesson, enriched parent-teacher partnership in building numeracy among the learners, difficulties for some pupils to count in Cebuano, and difficulties met in localizing, contextualizing and translating teaching materials for mathematics instruction. Strategies teachers use to develop numeracy skills of pupils using MTB-MLE along pedagogy were use of locally-made materials or objects found in the community, exposing pupils to more drills and exercises, attendance to seminars is helpful, Differentiated Instruction (DI), using manipulative, real and tangible object as instructional materials, translation, using collaborative approach teaching. There were different learning activities implemented to develop numeracy particularly in contextualization such as experiential learning; translation such as English nursery rhymes in Cebuano; indigenization such as use of local materials as instructional materials and localization such as involving community in the learning process. The gaps and issues encountered by teachers in developing literacy skills were the poor retention and low mastery of the four fundamental mathematical operation, complicating and varied learning competencies in the curriculum guide, and difficulties encountered by the pupils in mathematical problems.

Keywords — *Development of numeracy skills, math, teachers' experiences, phenomenology*

I. Introduction

This year, the government passed the Reading Improvement Act requiring schools to develop a reading intervention program for any kindergarten through third grade student identified as reading deficient through a reading assessment. The goal is for all students to be reading at or above grade level by the end of third grade. Due to these new requirements, schools are pressured to put even more of an emphasis on literacy skills and not necessarily numeracy skills. Schools are being forced to spend more instruction and intervention time on literacy, taking away from other subjects such as math.

However, research shows that literacy skills are not as much of a predictor of success than math skills are (Chesloff, 2019). There needs to be more of a focus on teaching math skills, especially early math and numeracy skills in early childhood. To help support young learners with early math and numeracy skills, parents and teachers need to know what early math skills are, why they are important, how they affect future academic success and strategies to create a strong math foundation in early childhood.

Early math and numeracy skills are crucial for later academic success. This includes math achievement as well as other subjects such as reading (Fuson, Sarama, & Clements, 2020). The main focus of this study, however, will be on the effect on future math classes. Several studies have shown the importance of early math (Aubrey & Godfrey, 2003; Aunio et al., 2015; Clerkin & Gilligan, 2018; Jordan et al., 2020). The learning that takes place during early childhood creates a foundation necessary for future math concepts and possible vocations. Teachers and parents play a crucial role in supporting and teaching these early math concepts. Without a strong foundation and proper teaching strategies and interventions, students will continue to struggle in math through elementary school.

The aim of this study is to explore early math and numeracy skills. It is crucial for parents and educators to be aware of the importance of teaching math skills in early childhood as the push for literacy increases possibly taking away time from math learning. This research will look at research to find the impact of early math and numeracy skills on later academic achievement, especially math achievement.

The focus of this study are the teachers of Jolencio R. Alberca Elementary School located in Tres de Mayo, Digos City. Through phenomenological approach with the use of interviews, the researcher will collect the narrative and responses of teachers to the teaching of math and numeracy skills to elementary learners.

With parents, early childhood educators, administrators, school districts and parents working together to create a more math-focused early childhood experience, learners will be able to begin a strong foundation of math skills early on. A strong foundation will lead to less students needing assistance later in elementary school and more enjoyment and success in future math classes. Children do not acquire early math skills on their own, they need a support system that works together in the best interest of the student. All parties play a role in early math education and are equally responsible for a student's math success. Hence, this study to determine what teachers are teaching in math and whether their teaching has an early effect on numeracy skills of the learners.

The study is guided by the following research questions:

1. What are the numeracy skills taught by teachers to the learners in the elementary grades?

2. What are the challenges encountered by teachers in teaching numeracy skills to the elementary learners?
3. What are the management insights of teachers to improve the teaching of numeracy skills to elementary learners?

Teaching math skills in early childhood are important because it is during that time that children are the most open to learning. Early math and numeracy skills build on children's natural curiosity, inquiry and exploration of the world around them (Chesloff, 2019; Harris & Petersen, 2019). Math at all ages requires curiosity and inquiry. Young students are naturally curious and learn through experiencing their surroundings. They want to know how things work and ask questions about everything. This is what makes early childhood the best time to begin learning early math and numeracy skills. Along with math skills, teaching early math helps to support verbal, spatial and memory skills in young children which are crucial in all areas of life and academics (Jordan et al., 2020). It is important to build the foundation for future math learning early by maximizing skills young students already possess.

Early math ability is directly related to future math ability and has been proven in several longitudinal studies (Aubrey & Godfrey, 2023; Aunio et al., 2019; Jordan et al., 2020). A student's ability to perform early math skills before formal schooling can predict their math achievement in the future. By teaching students these skills before first grade, students enter school with a foundation of skills to build on in order to do more advanced math. The Kindergarten Common Core skills, representing, relating and operating on whole numbers and describing shapes and space, which are early math skills, are essential for the skills students will learn up to third grade including operations, place value and geometry (Ramani & Eason, 2019). These skills do not stop being used in third grade either. Students will continue to use early math skills throughout the rest of their math education and life. Therefore, it is important to teach early math skills in early childhood.

In order to best prepare students for their future, teachers and parents need to explicitly teach early math concepts to children beginning as infants. Having a language rich environment where children can learn the academic language required for math, is extremely beneficial for young children to learn math concepts (Harris & Petersen, 2019). Children need to be able understand what they are being asked to do in order to be successful at math. If they do not know the language, they cannot perform the skills correctly. This can be done through daily interactions as well as purposeful play time (Harris & Petersen, 2019; Ramani & Eason, 2019; Toll & Van Luit, 2019). Young children can learn a significant amount of math language from playing with an adult or older child and hearing math words being used throughout such as sorting groups, number names and shape names. For students struggling with early math skills at any age, revisiting the academic language should be the first line of intervention (Toll & Van Luit, 2019). Solving math difficulties can be as easy as strengthening a student's academic language.

In order for early childhood teachers to be able to make the necessary changes to support early math development, they will need support and accommodations from administrators, such as principals. Many schools, such as the one I taught in for three years, have strict curriculum and time requirements for each subject. Typically, math has a significantly lower number of required minutes per day. Since the research in this literature review shows that early math skills are the most powerful predictor of future academic success, administrators will need to be willing to give math more time during the day even if it means taking away time from literacy (Aubrey & Godfrey, 2023; Aunio et al., 2019; Chesloff, 2019; Jordan et al., 2020; Kroesbergen et al., 2019). Early childhood teachers, along with administrators, will need professional development to learn how to better incorporate and teach early math and numeracy skills in preschool and Kindergarten. There will be a cost to hire a speaker to run a professional development course as well as the cost of substitute teachers for teachers to be able to attend during contract hours. Additionally, in a culture that pushes academic rigor, it will be important for administrators to see the benefit of play and games in the early childhood classroom and allow time in the schedule for this hands-on learning to take place (Weisberg, et al., 2019).

School districts can aid in the implementation of early math and numeracy in early childhood by providing schools with math interventionists in addition to reading interventionists. At the school I previously taught at, a Kindergartener could qualify for reading assistance as early as the second week of school but had to wait for math assistance until February. By providing math interventionists for each building and allowing them to work with early childhood students, at least Kindergarteners, immediately if a skills deficit is noticed, students can receive intentional help right away and not continue to struggle in math (Toll & Van Luit, 2019). This early intervention process can reduce the number of students who qualify for Specific Learning Disability in Math and help identify the students who truly have a learning disability, not lack of exposure, thus saving the district's special education resources (Clerkin & Gilligan, 2018). Students who are from low-income or non-English speaking home, need to especially be targeted for early intervention based on academic language to ensure they begin their academic career strong (Aunio et al., 2021). School districts will need to allocate more resources toward early childhood math but the hope is that with early intervention, students will not need the resources later on in elementary school.

This research also calls for a change in curriculum development for early childhood programs. Traditionally, the curriculum is based on literacy skills with math skills added in. However, from research by Jordan et al. (2020), Aubrey and Godfrey (2023), Aunio et al. (2021) and Clerkin and Gilligan (2018), it is now known that math needs to be a priority in early childhood learning. Literacy and math do not need to be exclusive when taught in early childhood, in fact, it is better if they are taught together as they use similar cognitive skills (Davidse, De Jong & Bus, 2019). However, early math skills cannot be an afterthought in curriculum planning, they must be a priority of equal or greater value as literacy. Early childhood educators need access to quality early childhood curriculum in order to be able to properly teach students early math skills and begin creating a strong foundation.

Although there are quite a few strong studies on the effect of early math and numeracy on future math success, there is very limited information or action research studies to show the correlation between early math skill and future general academic success. There needs to be more research on how early math success translates to other areas such as reading, social studies and science. Additionally, it would be very interesting to see longer studies that show how early math skills continue to affect math success through middle school, high school and college or occupations. We know early math skills create a necessary foundation for future math skills but the studies only test the correlation up to upper elementary school. It would be interesting to see how those same students continued to succeed or struggle in math classes for years to come. Do students every catch up? Does a student's math ability in preschool or Kindergarten accurately predict their math ability in high school? These are questions that would need to be answered with an in-depth phenomenological study.

The Integrated Theory of Numerical Development. The integrated theory of numerical development (Siegler, & Lortie-Forgues, 2019) proposes that the continuing growth of understanding of numerical magnitudes provides a unifying theme for numerical development. Within this perspective, numerical development is a process of broadening the set of numbers whose magnitudes, individually or in arithmetic combination, can be accurately represented. The theory identifies four main trends in numerical development: 1) representing increasingly precisely the magnitudes of numbers expressed non-symbolically, 2) linking non-symbolic to symbolic representations of numerical magnitudes, 3) extending the range of whole numbers whose magnitudes can be represented accurately, and 4) representing accurately the magnitudes of numbers other than whole numbers, in particular fractions, decimals, and negatives.

The integrative theory begins with the popular metaphor of the mental number line. However, it goes on to propose that this mental number line is a dynamic, continually changing, structure rather than a fixed, static one. Initially useful for organizing knowledge of non-symbolic numbers and then of small, positive, symbolic whole numbers, the mental number line is progressively extended rightward to represent larger symbolic whole numbers, leftward to represent negative numbers, and interstitially to representing symbolic fractions and decimals.

II. Methodology

This study utilized a descriptive qualitative research design. It was framed according to the conventions of phenomenological research approach as a tradition to qualitative research. It employed individual interview as a main instrument for this present study. Face-to-face interview sessions were restricted at the time that these data were being collected due to the prevailing COVID19 pandemic which guidelines were issued by the AITF. Data categorization was done on the responses of individual teacher. To categorize data, content analysis using conventional method (actual narrative) was employed. Recurrent themes and categories based from the

responses of the participants were taken as categorical themes to answer the different inquiries of this present research.

The participants of this research were the primary grades teachers from Kindergarten to Grade 6. Although, a qualitative research does not rely on the number of respondents as to the validity of the data, the researcher decided to conduct the interview to twelve (12) teachers of the school to compensate data whenever needed. These teacher-participants were in the teaching service for more than five years already in handling primary grades in Jolencio R. Alberca Elementary School (San Nicolas, Tres de Mayo, Digos City).

In qualitative research, data are collected with a focus on multifaceted interviews and narratives to produce a description of the experiences. The researchers, therefore, play the role of a mediator between the experiences of the respondents and the community of concerned people (Bloor, 2020; Todres, 2021). The post-interview comment sheet could assist the researcher to note the feelings of informants, as well as interpretations and comments that occurred during the interview (Guion, Diehl & McDonald, 2021).

Textual analysis is a broad term for various research methods used to describe, interpret and understand texts. All kinds of information can be gleaned from a text – from its literal meaning to the subtext, symbolism, assumptions, and values it reveals.

The methods used to conduct textual analysis depend on the field and the aims of the research. It often aims to connect the text to a broader social, political, cultural, or artistic context. Relatedly, it's good to be careful of [confirmation bias](#) when conducting these sorts of analyses, grounding your observations in clear and plausible ways.

III. Results and Discussion

Numeracy skills taught by teachers to the learners in the elementary grades

Several teachers' experiences were shared with the researcher on the responses during the interview. The experiences shared were categorized accordingly and themes were discussed in this section one after another: *smooth flow of instruction in Mathematics, enhanced engagement to instruction, enriched parents-teacher relationship, difficulties to count in Cebuano, and difficulties met in teaching materials for math instruction.*

Challenges encountered by teachers in teaching numeracy skills to the elementary learners

The following are challenges encountered by teachers in teaching numeracy skills to elementary learners: *use of locally-made materials, exposing learners to more drills and exercises, attendance to seminars, differentiated instruction, using manipulative, relia and tangible objects as instructional materials, translation, using collaborative teaching approach, retention and*

mastery of four fundamental math operations, complicating and varied learning competencies, and difficulties learners encountered in math problems.

Management insights of teachers to improve the teaching of numeracy skills to elementary learners

The following insights were expressed by teacher-participants: *experiential learning, English nursery rhymes in Cebuano, use of local materials as instructional materials, and involving community in the learning process.*

Analysis

Elementary teachers have varied positive and negative teaching experiences on the development of numeracy skills of elementary learners (using MTB-MLE). Elementary teachers applied different strategies in the pedagogy, learning engagement, assessment of learning to develop numeracy skills of elementary learners. Elementary teachers implemented varied and different learning activities implemented to develop numeracy skills particularly using Contextualization, Translation, Indigenization, and Localization.

There were challenges encountered by teachers in developing numeracy skills. Pedagogical knowledge of elementary teachers be refreshed, reviewed and upgraded. Other strategies of elementary teachers be used to upgrade their pedagogy, learning engagement in the classroom. Other learning activities on different relevant learning activities be developed using contextualization, translation, indigenization and localization. Relevant information, knowledge and skills be equipped to the elementary teachers so that they themselves may address the existing gaps and issues encountered in developing numeracy skills using MTB-MLE.

In the current early childhood realm, literacy is the main focus. However, based on the research outlined above, math needs to be a priority as well. Proficiency in early math skills such as counting, comparing and classifying, geometry and thinking skills create a necessary foundation for future math skills and success later in school. These skills are a crucial step in math development and cannot be skipped. Learners must know how to do the basic skills before they can learn more advanced skills. This also includes the ability to use and understand academic language in association with skills and abilities. Parents and early childhood educators are both responsible for introducing and teaching early math academic language along with skills both formally and informally. Learning can take place through daily interactions with numeracy activities and games, casual conversations about math concepts, and formal instruction time.

Play is a necessary part of early math learning as it gives students opportunities to use and practice their academic language alongside a skill. Based on the research found, integrating math into early childhood curriculum would be a beneficial change for future math courses and STEM occupations. Early math and numeracy skills not only pave the way for success in future math classes but also help students form a positive attitude toward math and learn basic executive functioning and problem-solving skills. The knowledge of early numeracy skills, the development

of math skills and the best practices for teaching these skills will help parents, early childhood educators and administrators best prepare young learners for a strong academic career. Early math and numeracy skills indeed have a strong impact on academic achievement throughout elementary school and therefore should be a main component of early childhood education.

IV. Conclusion

Early math and numeracy skills are a crucial beginning to academic success. The studies previously discussed show that young students who gain a strong foundation in math are significantly more likely to be successful in math throughout elementary school (Aunio et al., 2019; Jordan et al., 2020, Kroesbergen et al., 2019). Students must be able to count, compare and classify, do geometry and think critically in order to succeed in higher level math classes and perform higher level tasks such as fractions and algebra. Since early childhood learning takes place both at home and school, both educators and parents can benefit from knowing the importance of early math and numeracy skills and how to best teach young learners.

Early childhood teachers are the next biggest influences in a child's early math development. Teachers need to be instructed on how to integrate math into a literacy-focused curriculum and the importance of early math skills for future math success. They need to know how to create a language rich environment and incorporate academic language into the everyday preschool discussions (Toll & Van Luit, 2019). However, just integrating math is not enough. There needs to be a dedicated time for math instruction toward specific math goals or standards (Fuson, Sarama, & Clements, 2020). The easiest way for teachers to begin this change is through calendar time. Most early childhood classrooms already begin their day with calendar time so it would be simple to begin to add early numeracy skills into that time. It could be as simple as reading a book with numeracy concepts, counting the days of school every day, taking extra time to talk about the date or having a shape and number of the day to focus on. Clerkin and Gilligan (2018), explain how formal teaching of numeracy skills is an important part of math development. Calendar time is a simple way to add formal math instruction in an early childhood classroom. Informal teaching through play is also a valuable part of math development as well. By having numeracy and visual-spatial activities and games available for students to explore, students are able to apply and practice their math skills from calendar each day (Ramani & Eason, 2019).

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Chesloff, 2019; Jordan et al., 2020; Kroesbergen et al., 2019). Early childhood teachers, along with administrators, will need professional development to learn how to better incorporate and teach early math and numeracy skills in preschool and Kindergarten. There will be a cost to hire a speaker to run a professional development course as well as the cost of substitute teachers for teachers to be able to attend during contract hours. Additionally, in a culture that pushes academic rigor, it will be important for administrators to see the benefit of play and games in the early childhood classroom and allow time in the schedule for this hands-on learning to take place (Weisberg, et al., 2019).

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