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Kindergarten and elementary school teachers' numeracy knowledge and understanding

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ABSTRACT

Numeracy is essential for students to achieve academic success and develop practical problem-solving abilities in their daily lives. This study aims to investigate the integration of numeracy into the teaching practices of different lessons by elementary school and kindergarten teachers in Semarang, Indonesia. The data of this qualitative research were acquired from 26 teachers using a qualitative technique, which involved an open-ended questionnaire and the analysis of lesson plans. These two data collection techniques were triangulated to map teachers' perceived concept and planned practices of numeracy. The result of the study shows that only two of the four components of numeracy were known by the teachers, related to quantitative information (Domain I) and interpretation, representation, and communication (Domain III). Domain I, which pertains to quantitative information, is the most prominent. Still, Domain II, which relates to spatial information, and Domain IV, which encompasses strategies, techniques, and tools, are noticeably lacking. The study emphasizes the need to provide well-rounded teacher training that covers all aspects of numeracy in order to improve the quality of numeracy instructions. The implications indicate the need for specific professional development programs to solve these gaps, thereby enhancing students' numeracy skills and academic achievement. In this regard, the programs should cover conceptual and practical trainings and workshops for the four domains of numeracy and emphasize how to practically integrate them into different subject areas.

Keywords: application of numeracy components, elementary education, numeracy

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1. INTRODUCTION

1.1. Introduction

Numeracy has perpetually played a pivotal role in the educational advancement of students, particularly in their capacity to comprehend and engage with the surrounding environment. This article discusses the utilization of numeracy in teaching by primary school educators. It extends beyond basic arithmetic proficiency, encompassing a holistic grasp of mathematical principles essential for daily life and future educational hurdles. The capacity for

quantitative reasoning, problem-solving, and informed decision-making has emerged as the cornerstone of students' academic accomplishments and holistic growth (Kilpatrick et al., 2001).

Various pressing issues have shown the urgency of embedding numeracy into early childhood education. The result of the Program for International Student Assessment (PISA) in 2022 shows that Indonesia is ranked below the international average in Mathematics. This shows that the educational process needs to be improved, especially in developing numeracy skills as early as possible. This condition received direct attention from the Indonesian Ministry of Education and Culture. The ministry has commenced various programs that are aligned with UNESCO, which promotes a better-quality education by embedding essential skills into the curricula (UNESCO, 2017). As stated in UNESCO's Education 2023 Framework for Action, numeracy is a vital component of promoting better life-long learning.

Research in numeracy has been done in several aspects, like on the teaching strategies, curriculum, and the impact of numeracy on academic achievements. Duncan et al. (2007) show that numeracy serves as a predictor of academic success. In addition, Sarama & Clements (2009) and Geary et.al. (2009) emphasized that good treatment of numerical skills in early childhood education has a significant impact on mathematical comprehension and abilities. Further investigation was done by Watts et al. (2014), who proved that the teachers' views on numeracy have played roles in the teaching practices that embedded numeracy. When the teachers are confident with their numeracy knowledge, the teachers are not only confident but also successful in creating meaningful learning experiences for the students. In addition, Ma (1999) underlined the importance of teachers' mastering the numeracy components. When they have a deep understanding of numeracy concepts, they know the students' success indicators on numeracy. Consequently, the teachers are able to create activities that are relevant to the students' needs.

As Vygotsky's social constructivism theory (1978) mentioned, the learning process must incorporate social engagements. Therefore, numeracy skills are developed through collaborative tasks and guided teaching. Boaler et al. (Boaler et al., 2021) state that the learning environment must provide chances for the students to have discussions, exploration, and hands-on application of numeracy principles to improve the student's comprehension. By applying Bruner's (1960) concept of a spiral curriculum, the integration of numeracy within primary education can be done. Bruner emphasizes that students with maximum exposure to concepts gain optimal learning outcomes. The concepts must be given to the students repeatedly. Reinforcing fundamental skills is essential and relevant to numeracy education.

In addition to mathematics class, embedding numeracy to various subjects can improve the exposure of numeracy ideas to students. In science education, numeracy-focused activities can help students not only improve the students' problem-solving abilities but also a deeper comprehension of scientific principles (Tan & Ang, 2016). In addition, the use of statistical data of historical events and patterns can strengthen not only their numeracy skills but also their quantitative reasoning (Ćurčić et al., 2017). Numeracy can also be embedded in reading activities (Gloriani et al., 2023).

Theoretical frameworks

Numeracy refers to the ability to understand and work with numbers, encompassing a range of mathematical skills and concepts that are essential for daily life and further learning. The concept of numeracy was first proposed by Geoffrey Thomas in 1959 as part of his work on adult education in the United Kingdom. He defined it as the mirror image of literacy, emphasizing that just as literacy involves the ability to read and write, numeracy involves the ability to use numbers and mathematical reasoning effectively in everyday contexts (Thomas, 1959).

The pillars of numeracy encompass various skills and knowledge areas that enable individuals to function competently in a numerate environment. According to Steen (1990), numeracy involves Mathematical knowledge, application of mathematical skills, critical thinking and reasoning, communication, and confidence and disposition. Mathematical Knowledge concerns understanding fundamental mathematical concepts, such as arithmetic, algebra, geometry, and statistics. Application of Mathematical Skills deals with the ability to apply mathematical knowledge to solve real-world problems. Critical Thinking and Reasoning are associated with the capacity to analyze, interpret, and evaluate information, make decisions based on quantitative data, and reason logically. Communication constitutes the ability to explain and discuss mathematical ideas and solutions clearly and effectively. Finally, Confidence and Disposition refers to the ability to develop a positive attitude towards mathematics and confidence in one's ability to engage with mathematical tasks (Steen, 1990).

Numeracy knowledge comprises four main components: quantitative information, spatial information, interpretation and communication, and strategies, methods, or tools. Each component consists of several elements contributing to a comprehensive understanding of numeracy. Quantitative information pertains to numerical data that may be quantified and presented as a specific quantity. It covers a broad spectrum of mathematical skills and concepts essential for making informed judgments in everyday life. The elements of quantitative information include magnitude (understanding and comparing quantities, sizes, and scales,

whether they are small, large, whole numbers, fractions, decimals, or percentages), using numbers (utilizing numbers in various practical situations, like temperatures, and using numbers to indicate position or value), calculations (performing arithmetic operations such as addition, subtraction, multiplication, and division, fractions, decimals, rates, percentages, scales, and ratios), patterns and relationships (recognizing, analyzing, and using patterns to make predictions and understand relationships between quantities, including understanding sequences, trends, and mathematical relationships), organization of data (collecting, classifying, and organizing data systematically, involving creating and interpreting various types of data displays, such as charts, graphs, and tables.), calculation of data (using mathematical methods to process and analyze data, including performing operations on data sets to derive meaningful information.), interpretation of data (analyzing and drawing conclusions from data, including understanding graphs and charts, identifying trends, making inferences, and evaluating the reliability and validity of data.), and probability (understanding and applying concepts of probability to make informed decisions, including assessing the likelihood of events, understanding probability language, and using probability in real-life situations) (Alberta Education, 2017).

Spatial information refers to the precise geographical position of objects or people and their relationships. It entails comprehending and analyzing the spatial elements of the environment, which is crucial for navigating, arranging, and resolving problems in different situations. The elements of spatial information include spatial visualization (the ability to visualize and manipulate objects in space, involving understanding shapes, sizes, positions, and movements, as well as creating and interpreting diagrams and models), management of space (judging and using space effectively, including understanding spatial relationships, navigating environments, and using space efficiently in various contexts), measurement (understanding and applying measurement concepts, including using units of measurement, measuring tools, and techniques for length, area, volume, weight, time, and other attributes), conversion (the ability to convert between different units of measurement, involving understanding and applying conversion factors within and between measurement systems), time (understanding and using concepts of time, including measuring and calculating time intervals, sequencing events, and understanding various representations of time.), and location and direction (the ability to navigate and understand positional information, including using maps, coordinates, and directional language to describe and find locations) (Alberta Education, 2017).

The right perception, representation, and delivery of information are necessary for exhibiting numeracy skills. These elements encompass the comprehension and portrayal of

quantitative information (the capacity to comprehend and generate diverse representations of numerical data, such as graphs, tables, and charts, involving the accurate and effective interpretation of quantitative information), interpretation and representation of spatial information (comprehending and creating representations of spatial information, such as maps, diagrams, and models, involving visualizing spatial relationships and transforming them into understandable formats), and communication (the ability to communicate mathematical ideas clearly and effectively using suitable terminology, symbols, and representations). This encompasses the act of elucidating solutions, rationale, and procedures to others) (Alberta Education, 2017).

The last component of numeracy is utilizing efficient and effective methodologies, techniques, or tools in managing quantitative or spatial data. These components include the strategies of choosing suitable methods based on the problem, employing estimation techniques to validate the reliability of outcomes, and utilizing calculators, software, and other resources to improve problem-solving and data interpretation (Alberta Education, 2017). In addition, it is also proven that the use of digital technologies can improve the students' knowledge (Geiger et al., 2015).

Numeracy Education

Critical thinking is one of the life skills needed to navigate the world. Providing education that equips students with critical thinking can be done by employing numeracy skills in teaching, as mathematical proficiency is needed to apply their reasoning and problem-solving abilities in various contexts. Therefore, a holistic curriculum that integrates numeracy skills across different subjects and real-life situations must be developed. Duncan et. al. (2007) has shown that thorough instruction in numeracy education needs to be done in primary education. Sarama and Clements (2009) also show that numeracy interventions in childhood can improve the children's numerical abilities to support their future, so pre-school teachers can also do different activities to teach numeracy (Bautista et al., 2019).

As with all educational processes, teachers play an important role in the learning process. Teachers' skills have a positive relation with the quality of the education provided. Well-versed teachers in numeracy are better at developing students' numeracy (Ma, 1999). Furthermore, teachers' attitudes and behaviors towards numeracy significantly influence the students' learning experiences (Anthony and Walshaw, 2007). Integrating numeracy into different subjects has become another important way in numeracy education. Infusing

numeracy science education boosts the students' problem-solving skills and strengthens their grasp of scientific principles (Tan & Ang, 2016; Treacy, 2018).

In conclusion, numeracy represents a critical skill encompassing multiple mathematical competencies essential for daily life and ongoing education. Numeracy education cultivates these skills through early interventions, effective teaching approaches, and curricular integration. By grasping and applying these constituents, teachers can enhance students' arithmetic skills, ultimately contributing to their overall academic achievement and ongoing education.

1.2. Research questions

Despite these previous studies, the awareness of effectively integrating numeracy into daily instructional practices among elementary school educators remains low. This research aims to address this gap by exploring teachers' perspectives on numeracy within their classrooms, presenting a comprehensive evaluation of current methodologies and potential avenues for improvement. This study seeks to investigate the degree to which elementary school and kindergarten teachers include numeracy within their teaching practices. The specific research questions are formulated as follows: 1. To what extent do elementary school teachers take a stance on numeracy? And 2. To what extent do kindergarten teachers take a stance on numeracy?

1.3. Significance of the study

By understanding how numeracy is integrated into the curriculum and daily classroom activities, this study bears practical and theoretical significance. The practices can be implemented in broader areas and modified to be applied in other subjects. In addition, what has not been optimally implemented can be a room for improvement and for reflective teaching. Theoretically, the findings can add to the numeracy body of knowledge, particularly in relation to kindergarten and elementary school teachers. ~~we can identify strengths and areas for development, ultimately contributing to enhancing numeracy education in Indonesia and beyond.~~

2. METHOD

2.1. Research Design

This study was qualitative as it attempted to understand how teachers view the numeracy concept. To get in-depth understanding of the phenomenon, we used several data collection techniques through a questionnaire and documentation of teachers' lesson plans (Creswell & Poth, 2018). The questionnaire was administered because it is more feasible for a

relatively high number of participants, meanwhile the lesson plans were analysed for the reason of looking into how the participants express naturally what they know and understand about numeracy into their own teaching. These two techniques, while they were aimed at the purpose of this study, were used to prevent the participants' worrisome of being directly confronted in face-to-face encounters, which may affect the trustworthiness of the data.

2.2. Samples/Participants

A total of 26 teachers from a private elementary school and a kindergarten in Semarang, Indonesia, participated in the survey. They constituted 17 elementary school teachers and 8 kindergarten teachers. They were chosen based on their willingness to participate in this study. The participants from each school showed unequal numbers since we included the whole school population, so no teachers were excluded in this study. The teachers participating in this study were those teaching at a private elementary school and kindergarten for at least 2 years. Their subject of teaching ranged from mathematics, science, language, social studies, and sports. To collect the data, permission to visit the school was first arranged. As permission was granted, the questionnaire was developed and input into Google Forms. The form was then distributed to the teachers in the schools as the researchers met the teachers in person. Each teacher was guided in responding to the questionnaire. Since they are native Indonesian speakers, the questionnaire was written in Bahasa Indonesia. This was intended to alleviate misunderstanding when they answered the questions in the questionnaire, so this can also improve the reliability of the instruments.

2.3. Instruments

In this study, the researchers used two instruments: a questionnaire and documentation of the teachers' lesson plans. The questionnaire was used to obtain a variety of respondents so that their understanding of the numeracy concept may vary. This is also beneficial to get a clear portrayal of their view of numeracy. In addition, teachers' lesson plans were collected to go into the alignment of their numeracy understanding with its implementation in the classroom through the lesson plans. The combination of these instruments was to look into not only teacher-perceived concepts, but also teacher-practiced concepts. In other words, this allows this study to portray how numeracy is understood by the teachers and how it is integrated.

2.4. Data analysis

To analyze the data, the data were first translated into English and classified into two groups: elementary school teachers and kindergarten teachers. The original version and the translated version were read repeatedly to ensure the equivalence of the translated version.

Each data set was then put in a table to categorize it based on the framework of numeracy developed by Alberta Education (2017). Each categorized datum was coded to indicate the association with the framework. Moreover, the categorizations were verified with the data from the lesson plans. The results were displayed and interpreted as the data from the two data collection techniques were triangulated. The triangulation was carried out to increase the reliability of the findings that what is presented in the findings are consistent with the sets of data and to conform to the validity that the findings are exactly the manifestations of what so-called numeracy based on the theory and reflected in the collected data.

3.FINDINGS AND DISCUSSION

3.1. Findings

Teachers' numeracy knowledge and understanding

The findings show some noteworthy differences. Out of 26 respondents, only four respondents have ever joined numeracy training, entailing three teachers from the elementary school and one teacher from the kindergarten. Their participation in numeracy training partially aligns with their knowledge and understanding of numeracy. In this sense, numeracy knowledge and understanding comprise four main domains encompassing quantitative information, spatial information, interpretation, representation and communication, and lastly strategies, methods, and tools (Alberta Education, 2017). As the framework provides a comprehensive view of numeracy, fewer teachers have a thorough knowledge of this concept, as shown in the following table.

Table 1. The teachers' numeracy knowledge and understanding

No	Teachers	Domain I	Domain II	Domain III	Domain IV
1.	Elementary School Teachers	17	1	6	-
2.	Kindergarten Teachers	8	-	2	-

(Domain I = Quantitative Information; Domain II = Spatial Information; Domain III = Interpretation, Representation, and Communication; Domain IV = Strategies, Methods, and Tools)

The table presents data on the numeracy knowledge and understanding of teachers from two different educational levels: elementary school and kindergarten. The data are divided into four domains of numeracy, with each domain likely representing different aspects or competencies within numeracy education. Elementary school teachers show a strong foundation in Domain I, with 17 teachers demonstrating knowledge and understanding in this area. However, there is a significant gap in Domain II, with only one teacher possessing the

necessary knowledge, suggesting a need for improvement. In Domain III, six teachers have the required competency, indicating a moderate level of understanding. Notably, no elementary school teachers are listed for Domain IV, pointing to either a lack of data or an absence of knowledge in this domain.

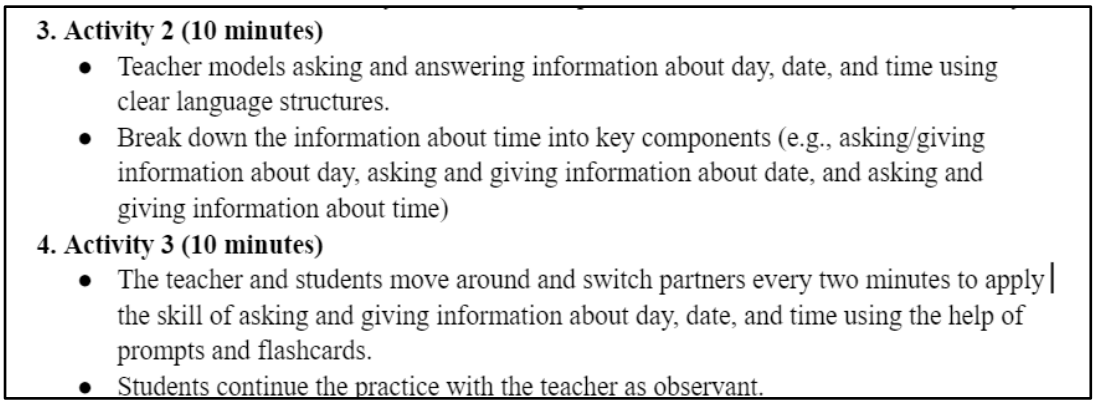
Kindergarten teachers also exhibit the highest level of knowledge in Domain I, though the number is lower, with eight teachers showing understanding in this area. There is a complete absence of knowledge in Domain II among kindergarten teachers, highlighting a critical area for development. In Domain III, only two teachers have the necessary competency, reflecting limited understanding that numeracy also deals with the ability to interpret, represent, and communicate ideas. Similar to elementary school teachers, no kindergarten teachers are represented in Domain IV, suggesting a potential gap in training or curriculum coverage for some equipment to assist students in numerical activities.

The table reveals several key insights into the numeracy knowledge and understanding of teachers at different educational levels. Both groups show the strongest knowledge in Domain I, indicating that this area covers fundamental skills that are essential and more commonly addressed in teacher education programs. However, Domain II is a notable area of deficiency, especially among kindergarten teachers, indicating that the information in this domain may be more advanced or get less emphasis in their training. Both groups have a modest level of proficiency in Domain III, indicating some familiarity but indicating the need for growth. The lack of data or representation in Domain IV for both groups indicate a possible gap in the curriculum or training programs that requires improvement.

To address these identified gaps and weaknesses, it is recommended to implement targeted professional development programs focusing on Domains II and IV to enhance teachers' competencies. Reviewing and revising teacher education curricula to ensure balanced coverage of all numeracy domains is also crucial. Regular assessments and follow-ups should be conducted to monitor improvements and adjust training programs accordingly. Additionally, allocating resources and support to areas with identified weaknesses will help teachers build their knowledge and understanding in those domains. By addressing these areas, educational institutions can work towards providing a more comprehensive and effective numeracy education for teachers, ultimately benefiting the students they teach.

This is also evident in the lesson plan written by the elementary school teachers on the application of the first, second, and third domains. The first domain, Quantitative Information, is realized in lesson plans through activities that involve numerical data, measurements, and calculations. For instance, an elementary school lesson plan on English lessons include the use

of numbers, especially to show time. The students are asked to give information about day, date, and time.



3. Activity 2 (10 minutes)

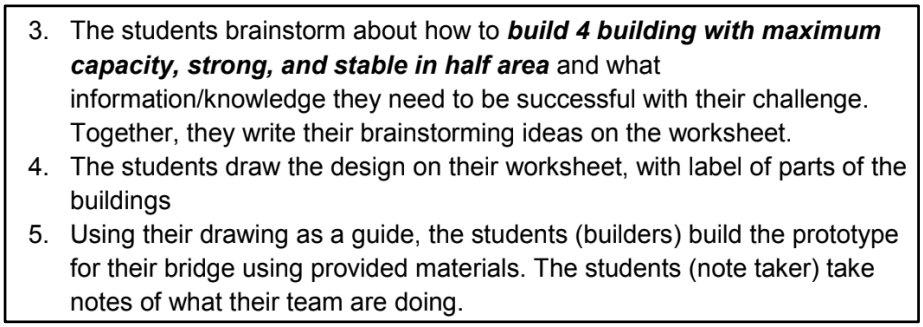
- Teacher models asking and answering information about day, date, and time using clear language structures.
- Break down the information about time into key components (e.g., asking/giving information about day, asking and giving information about date, and asking and giving information about time)

4. Activity 3 (10 minutes)

- The teacher and students move around and switch partners every two minutes to apply the skill of asking and giving information about day, date, and time using the help of prompts and flashcards.
- Students continue the practice with the teacher as observant.

Figure 1. The realization of Quantitative Information in the elementary school Lesson Plan

Spatial Information, the second domain, is evident in activities that involve understanding and manipulating shapes, spaces, and spatial relationships. An elementary school lesson plan might include tasks where students create and interpret maps or models, navigate spaces, and measure distances. For example, in Mathematics, students learn about shapes or geometry. Using project-based learning, the teacher plans to create a cube city using 3D shapes in certain areas. In this lesson, the students have to be able to measure the size of the cubes made from paper. This helps students develop spatial visualization and management of space.



3. The students brainstorm about how to ***build 4 building with maximum capacity, strong, and stable in half area*** and what information/knowledge they need to be successful with their challenge. Together, they write their brainstorming ideas on the worksheet.
4. The students draw the design on their worksheet, with label of parts of the buildings
5. Using their drawing as a guide, the students (builders) build the prototype for their bridge using provided materials. The students (note taker) take notes of what their team are doing.

Figure 2. The realization of Spatial Information in the Lesson Plan

Put a tick on the answer

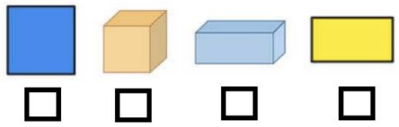
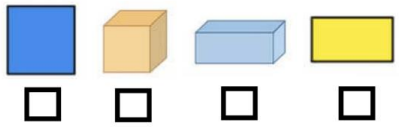
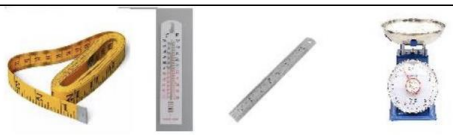
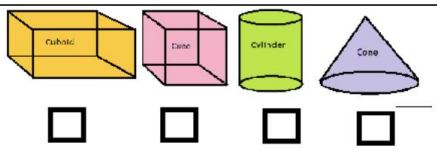
No	Question	Answer
1	Which one are belong to 2 d shapes?	
2	Which one are belong to 3 d shapes?	
3	What will you use to measure width or length ?	
4	Which one that will have big capacity ?	

Figure 3. The realization of Spatial Information in the elementary school Lesson Plan

Figures 2 and 3 demonstrate spatial information that the students need to practice. Referring to the literacy and numeracy progression, the activity that the teacher promoted in the lesson plan belongs to Measurement in which the students compare different objects. As shown in Figure 3, the first and second questions in the task have the students compare 2D and 3D objects. In the third question, the students are asked to decide which tool to use in measuring width and length. Finally, in the fourth question, the students must decide the biggest capacity in the given options. These are all concerned with spatial information which in nature is a vital component to numeracy.

The third domain, Interpretation, Representation, and Communication is reflected in lesson plans that emphasize the ability to interpret and create various representations of data, as well as communicate mathematical ideas effectively. An example of this can be seen in a science lesson where the students collect data from an experiment using muscular force. The students must draw different activities using muscular force to move a thing. After that, the students present it by demonstrating the activities in front of the class.

A project on the effect of muscular force to things.

1. Look for an object around you.
2. You will consider this object as a container owned by Aga and Dara.
3. Try various ways to move the container.
4. Write down all the methods you can use on your worksheet. Make a sketch of the methods you have found. Draw as best as you can!
5. Once you are done, demonstrate the methods you have found in front of the class!

Figure 3. The realization of Interpretation, Representation, and Communication in the elementary school Lesson Plan

In a kindergarten lesson plan, Spatial Information is also found in the learning activities. For example, students learn how to set up campfires. The teacher uses matchsticks to explain and show what campfire is. In this lesson, the students develop spatial visualization as they need to learn and imagine how to arrange the matchsticks, so the campfire can ignite quickly.

Exploration Through the project activity of creating a campfire using matchsticks, children are given knowledge about campfires and how to make a campfire.
Explanation The teacher explains how to arrange matchsticks into a campfire, how many matchsticks are needed to make a campfire, how to light the campfire so that the fire can ignite quickly, and how to attach the matchsticks so they stick firmly to the paper medium.
Elaboration Through the activity of reviewing what has been done, the teacher and students together solve new problems encountered (e.g., when the arrangement of matchsticks is not neat, causing some sticks not to stick, when too little glue is used, making it easy to peel off, etc.) until the desired result is achieved.

Figure 4. The realization of Spatial Information in the kindergarten Lesson Plan

In addition, Interpretation, Representation, and Communication are also implemented in a kindergarten lesson plan. For example, students learn how to navigate through different types of balance beams. They need to interpret the distance of the balance beams while holding different objects, like soil, water, and air. The students need to measure how much soil or water is spilled at the end of the balance beams. After that, they need to present the reason why they have some soil and water left after passing the balance beam. In this lesson, the students not only develop interpretation but also communication.

Explanation
The teacher explains how to navigate different types of balance beams.
Elaboration
Through activities that involve revisiting what has been done, the teacher and students together solve new problems encountered (for example, when a child maintains balance on the beam while carrying an object, what happens when a child enters a tub of soil, a tub of water, etc.) until the desired results are achieved.
Evaluation
Evaluation is carried out with self and peer assessment on the process and results when playing with water, air, and soil.
Note: If the project is not yet completed/not meeting the expected criteria/degree, the project can be continued the next day to produce the best possible project. The following day, a presentation will be given on what has been done with the project.

Figure 5. The realization of Interpretation, Representation, and Communication in the Lesson Plan in the kindergarten Lesson Plan

3.2. Discussion

The numeracy concept among the teachers

Based on the findings, the teachers participating in this study show an emerging capacity of knowledge and understanding to integrate numeracy in their teaching, albeit in the absence in Domain IV, concerning strategies, methods, and tools. Another noteworthy finding is that Quantitative Information is found to be the most dominant area. In other words, most of the teachers considered this domain to be one strong pillar of numeracy. Moreover, while Spatial Information was not acknowledged among the kindergarten teachers, there was only one teacher from the elementary school who had knowledge about it. Therefore, the discussion is going to interpret and synthesize the three major findings.

The lack of knowledge and understanding of Domain IV seemingly indicates a gap in teacher training and professional development programs. It implies that teachers may lack the necessary skills to teach students how to approach problems strategically, make reasonable estimations, and use various tools and methods to solve mathematical problems. This gap can significantly affect students' numeracy development, as they might not learn how to apply their quantitative knowledge in practical and strategic ways. Improving this condition is crucial. Integrating training on strategies, methods, and tools into teacher education programs can enhance teachers' ability to provide a more comprehensive numeracy education. By doing so, students can develop not only the basic skills but also the strategic and problem-solving abilities that are essential for higher-level mathematical thinking and real-world applications.

According to Ma (Ma, 1999), teachers with profound knowledge of fundamental mathematics are more capable of fostering students' numeracy development.

The close relationship between numeracy and quantitative information is inevitable. This is also what most of the teachers know and understand. This finding corresponds to the previous studies that teachers' knowledge and understanding of numeracy are still limited to numerical objects, quantity, or numbers (Melissa & Kristanto, 2024; Sayekti & Sukestiyarno, 2021; Smith & Cekiso, 2020). If this issue is taken for granted, it will impact the learning experiences of students, in addition to impeding pedagogical practices. To tackle this, Melissa and Kristanto (2024) suggest numeracy training and professional development of teachers. Considering the sole relationship between numeracy and numbers is misleading. Research has shown the influence of Spatial Information on numeracy skills (Diezmann & Lowrie, 2012; Duncan et al., 2007). Therefore, a complete understanding and knowledge of numeracy is what teachers necessitate to make the most of students' learning.

The investigation revealed that Domain I, concentrating on quantitative data, stood out as the most significant area of expertise. This indicates that educators demonstrate a considerable level of ease and familiarity with fundamental numerical elements, such as size, numerical operations, calculations, patterns, data arrangement, data computation, data interpretation, and likelihood. The evidence suggests that teacher training schemes and classroom lessons effectively tackle the basic aspects of numeracy. This outcome bears significant importance. A profound grasp of quantitative data is indispensable for honing students' foundational numeracy abilities, which are crucial for their academic endeavors and everyday tasks. Nonetheless, a predominant emphasis on this particular domain may result in a restricted understanding of numeracy, potentially limiting students' capacity to apply these skills across diverse scenarios. Integrating numeracy into other domains enhances students' numeracy development, as asserted by Duncan et al. (2007). Therefore, teachers need to be encouraged to apply different numeracy components in their teaching approaches as interventions to young-age education have a great impact on the students' numeracy (Gable et al., 2021; Lindström-Sandahl et al., 2024; Nelson & McMAster, 2019; Sarama & Clements, 2009).

Spatial knowledge, as the second domain of numeracy components, cannot be found in the lesson plans developed by kindergarten teachers. This condition shows that preschool teachers are not prepared to teach spatial concepts, which are essential for future subjects like science, English, geography, and many others. Preschool teachers themselves might lack exposure to indicators of spatial information. Filling this insufficiency is critical for ensuring a robust foundation in the numeracy education of young students. Therefore, teachers need to be

equipped with information on numeracy components and the indicators and be trained on how to plan the learning activities incorporating the numeracy skills as teachers' perception and actions are closely related (Anthony & Walshaw, 2007).

Conclusion

This study has some important findings on elementary school and kindergarten teachers' comprehension of numeracy literacy. Of the four domains of numeracy components, quantitative information (domain I) and domain III (interpretation, representation, and communication) occur as the most recognized component. This suggested that teachers have a high knowledge of the fundamental numeracy skills, which are needed for the next level of learning and in their everyday life. However, another result shows that there is an absence of the fourth domain (the use of strategies, techniques, and tools) in the lesson plans. In addition, kindergarten teachers also do not employ the second domain (spatial knowledge). This condition shows that teachers have no knowledge of these numeracy components. The result also shows that teachers' inadequate knowledge of numeracy components can be seen on the lesson plans.

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