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Numerical Literacy and Math Self-Concept: Children-Friendly Learning in Inclusive Elementary Schools

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Abstract: Numerical literacy refers to the knowledge and ability to use various numbers and basic mathematical symbols to solve problems, while math self-concept means the assessment of students' skills, abilities, enjoyment, and interest in the subject. However, children with special needs and normal students in inclusive Elementary Schools are yet to sufficiently acquire learning that accommodates literacy and maths self-concept. This causes a need for the implementation of a children-friendly learning process. Therefore, this study aimed to identify the factors influencing the numeracy level and math self-concept, and also explore the obstacles in implementing children-friendly learning in order to facilitate students' abilities. A qualitative method was applied because of in-depth data exploration regarding children with special needs, while the utilized instruments include tests, questionnaires, and interviews. Both the data collected and the analysis are qualitative, which are obtained through excavation, identification, and description. Consequently, this paper was able to (a) describe the factors influencing the numeracy level and math self-concept in inclusive elementary schools; (b) explore the barriers to implementing children-friendly learning; and (c) identify the relationship between students' numeracy and math self-concept.

Keywords: *Children-friendly learning, inclusive elementary school, math self-concept, numerical literacy.*

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Introduction

Literacy is a tool that effectively contributes to creating better educational conditions (Genlott & Grönlund, 2016), and it is divided into 6 basic types, namely reading and writing, numerical, scientific, digital, financial, as well as cultural and civic (Konopko, 2015). Numeration is the ability to understand and manipulate data in everyday life, and its understanding helps to make the right decisions (Sibaen, 2022). This is consistent with the discovery of that numerical thinking is needed to recognize, interpret, determine patterns, and solve life context problems (Nurwidodo et al., 2020). Also found that numerical literacy is indicated by the convenience of numbers and the ability to utilize mathematical skills, as well as the interpretation of analysis results when predicting and making decisions (Han, 2017).

Math self-concept is a crucial factor in mathematics education, and it is known as an assessment of students' skills, abilities, enjoyment, and interest in the subject (Erdogan & Sengul, 2014). This factor also needs to be considered when determining adaptation success or failure, concerning the intelligence required to succeed in mathematics (Heyder et al., 2019). Unfortunately, children with special needs are yet to acquire math self-concepts based on their learning needs.

Inclusive education is based on human rights and social models, a system that needs to be adapted to children, not otherwise. Children with special needs are expected to have the same rights as normal children when obtaining standard, effective, and sustainable education (Thomas & Bacon, 2013). Children with special needs as mathematics learners need special instruction to overcome obstacles outside the teaching and learning of this subject (Kunwar et al., 2021). This is because Elementary School children are in the concrete operational stage, in which their logical thinking develops (Riyadi et al., 2021). Further explained that in an inclusive student setting, children with special needs are

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educated in class with regular students (Gorges et al., 2018). Therefore, “inclusive school” is only considered a formality, even though special education for students is necessary to track their progress.

A well-functioning children-friendly model often impacts the development of schools and students positively (Fitriani et al., 2021). This model refers to the school concept of implementing the learning process according to the children's psychological development by ensuring safety, comfort, and equity in line with the equality principle (Muarifah et al., 2020). However, student's inability to apply their mathematical knowledge in other fields directly indicates the need for an educator's supervision.

From the explanations above, numeracy and math self-concept are very important in inclusive elementary school. Numerical literacy enables elementary school children to understand arithmetic and to use practical math skills in life. Unfortunately, there are still shortcomings in numeracy at Elementary Schools, such as failure to implement numeracy and math self-concept among children in inclusive schools, thereby causing a gap between the ideal needs and the facts in the field. This means numeracy and math self-concept is required in inclusive elementary schools since no children-friendly learning and numeracy literacy have been implemented. The research questions in this study were to describe the factors that influence the level of numeracy and mathematics self-concept in inclusive elementary schools, explore barriers to implementing child-friendly learning, and identify the relationship between numeracy and mathematics self-concept.

Methodology

Research Design

This study uses a qualitative approach to explore, identify, and describe the acquisition of numeracy skills as well as math self-concept in inclusive elementary schools. The first stage entailed preliminary and theoretical studies through a systematic literature review to identify, assess, and interpret all relevant reputable articles when determining the gaps (Sugiyono, 2011).

In the second step, tests, interviews, and questionnaires were conducted. The test contained numeracy questions according to the Ministry of Education, Culture, and Technology's minimum competency assessment indicators. This is included in the cognitive test in order to determine the students' numeracy skill levels. Furthermore, the test encompassed complex multiple choice questions with more than one correct answer and also requires students to organize and state answers using their sentences. Interviews were conducted with teachers and students in primary schools that provide inclusive education for children with special needs. Afterward, the interview indicators were obtained from the study formulation, which was later divided into two, including interviews for teachers and sheets for students. Questionnaires are presented in the form of statements to obtain information from respondents, which include children with special needs and normal individuals in grade 5. The indicators utilized in the questionnaire include math self-concept, consisting of class participation, doing assignments, confidence in class, and independent learning. The respondents' answers collected were tabulated according to math self-concept level.

The instrument was tested before being used to measure students in the sample class. The trial is intended to determine the validity and reliability. Researchers conduct tests to obtain valid items, and invalid items will not be used in research. Instrument and angle tests are said to be valid if they can measure what is to be measured. Validity testing was carried out using SPSS 22. This test was carried out using the Bivariate Person technique (Product Moment Correlation). This validity test is used to test the validity of test questions and questionnaires. The validation of this test is seen from its significance value on the sig line. (2-tail). By looking at the Significance value (Sig.), that is, if the Significance value is less than 0.05 then it is declared valid, if the Significance value is more than 0.05 then it is declared invalid.

After the research instrument was tested for validity, then the reliability test was carried out. Test reliability and angle refer to the notion of a test and angle can consistently measure something that will be measured from time to time. Test instruments and questionnaires can produce measurements that are fixed, and do not change if used repeatedly with the same target, it can be said that the test is reliable. The reliability test used to test the reliability of the Pretest and Posttest uses Cronbach's Alpha with the help of SPSS 22. The test criteria use Cronbach's Alpha, namely as an instrument, it is said to be reliable if Cronbach's Alpha > 0.05.

The third step involved the collection of test data, interviews, and questionnaire results. Based on the data obtained, descriptive qualitative analysis was employed. The analysis began with data collection and classification as a basis for drawing conclusions, which entails numeracy and math self-concept descriptions for children with special needs in inclusive primary schools. There are four stages in data analysis, namely collection, reduction, presentation, and verification or conclusion. Data collection involved tests, interviews, and observation techniques, while the reduction was performed through selection, subject matter focus, abstraction, and transformation of field data. The presentation of a structured information set provided an opportunity to draw conclusions and take further action, meanwhile, the data obtained were used to conclude objectively. In checking the qualitative data validity, a credibility test was performed using triangulation, such as technical triangulation. These four stages form an interrelated cycle and run continuously until a conclusion was obtained.

In the fourth step, hypotheses and results were generated to answer the problem after analyzing the tests, interviews, and questionnaires for examining the students' numerical literacy and math self-concept in inclusive Elementary Schools. The results achieved were a description of child-friendly learning implementation to facilitate students' numeracy and math self-concept.

Study Subject

This study was conducted on 5th-grade students at seven (7) inclusive elementary schools in Yogyakarta Special Region. The object was students' numerical literacy and math self-concept with children-friendly learning. This study was performed in the even semester of the 2021/2022 academic year and two criteria were utilized in selecting the subjects, namely Elementary Schools that provide inclusive education for children with special needs and grade 5 students consisting of both normal and special-needs children.

Results

Numerical Literacy Test Results

The numerical literacy test measures students' ability to apply mathematical facts, concepts, and procedures in problem-solving. In the complex multiple choice questions, more than one correct option was provided but the essay requires students to organize and state answers using their sentences/statements. The Minimum Competency Assessment components were conducted to determine numeracy skills, which include the students' proximity context to social, cultural, environmental, scientific, and mathematical science domains.

1. Pay attention to the following text and table!

SEWING MASK BUSINESS

Kresna owns a sewing cloth mask business which he manages with his family. In his business, Kresna uses 3 types of materials, namely OKboy cloth, cotton cloth, and batik cotton cloth. The following table shows the production cost and selling price of masks per piece by material.

Ingredients	Cost of Production	Selling Price
OKBoy	Rp. 40.000,00	Rp. 45.000,00
Katun	Rp. 43.000,00	Rp. 46.000,00
Batik Katun	Rp. 50.000,00	Rp. 57.000,00

Today, 2,000 masks made from OKboy sold, with 5% of the masks sold being purchased by Andi to be donated to the victims of the Bojong Asih flash flood. Andi's cost to buy masks is

Answer

Figure 1. Example of Numerical Literacy Questions

The test consists of 5 questions based on the minimum competency assessment indicators for numerical literacy. Tests at 7 schools, comprising 9 children with special needs and 46 normal students produced the following data:

Table 1. Numerical Literacy Test Results

Classification	Students with special needs	Normal Students	Total Students	Percentage of Special-needs Students	Percentage of Normal Students	Percentage of Total Students
Very good	0	2	2	0	4.348	2.17
Good	0	5	5	0	10.87	5.44
Average	1	8	9	11.11	17.39	14.30
Deficient	2	28	5	22.22	6.522	14.40
Very Deficient	6	3	34	66.67	60.87	63.80
Total	9	46	55	100	100	100
Category	Very Deficient	Deficient	Deficient			

From the analysis results, the numeracy abilities of children with special needs were in the average, deficient, and very deficient categories of 11.11%, 22.22%, and 66.67%, respectively. This means the average numerical literacy ability is very deficient. Also, normal students were categorized as very good, good, average, deficient, and very deficient with the respective values of 4.34%, 10.87%, 17.39%, 6.52%, and 60.77%, respectively. This means the average numeracy ability of normal children was deficient. Figs. 2 and 3 are examples of students' responses in the deficient and good categories regarding the numeracy test.

$$2000 \times \frac{455}{100} = 100 \times \text{Rp } 45.000,00 = 4.500.0000$$

Figure 2. Example of Answers for Deficient Category

According to Fig. 2, students in the very deficient category only wrote the answer of 4,500,000. This is still far from the numeracy test aspect, indicating that students were:

1. Unable to solve all numeracy literacy problems correctly.
2. Unable to answer questions that measure simple numeracy literacy skills.
3. Unable to apply known mathematical facts and concepts.
4. Not applying mathematical procedures to perfectly solve daily problems.

$$\frac{5}{100} \times 2.000 = 100 \text{ buah}$$

$$10 \times \text{Rp. } 45.000 = \text{Rp. } 4.500.000$$

jadi, biaya yang dikeluarkan Andi adalah Rp. 9.500.000

$$\frac{5}{100} \times 2.000 = 100 \text{ pcs}$$

$$10 \times \text{Rp. } 45.000 = \text{Rp. } 4.500.000$$

So the costs incurred Andi are Rp. 4.500.000

Figure 3. Examples of Answers for Good Category

In Fig. 3, students categorized as good only wrote incomplete description answers. However, several stages of mathematical operations were completed, indicating that:

1. Students were unable to apply the facts and mathematical concepts when solving everyday problems perfectly.
2. Students were unable to provide reasons for using their sentences with two or more correct answers.
3. Students were not able to apply procedures when solving daily problems perfectly.

In addition, there are children with special needs who scored 0, verified with a blank answer sheet. Ideally, to achieve a minimum good numeracy category, students need to apply known facts, concepts, and mathematical procedures in order to solve daily problems, seen from the use of sentences with more than two correct answers.

It was observed that students generally do not know the correctness of their answers. Students do not fully understand the mathematical concepts learned at school because they only understood that the subject is about numbers and counting. Children with special needs were mostly confused, despite answering the questions. They only answer based on their thoughts and hope that these thoughts were related to the questions. Therefore, their inability to analyze questions resulted in the average numeracy score being categorized as "very deficient".

Math Self-Concept Questionnaire Results

The questionnaire was used to obtain information about the math self-concept of grade 5 students attending Elementary Schools that provide inclusive education. The respondents' answers were then tabulated according to the math self-concept level as it is a good predictor for assessing students' self-perceptions development in mathematics achievement. It consists of four concepts, namely class participation, doing assignments, confidence in class, and independent learning (Legette & Kurtz-Costes, 2020).

Table 2. Assessment Criteria of the Math Self-Concept Questionnaire

Criteria	Students with special needs	Normal Students	Total Students	Percentage of Special-needs Students	Percentage of Normal Students
Very good	0	3	3	0	6.82
Good	5	25	30	55.56	56.80
Average	3	15	18	33.33	34.10
Deficient	1	1	2	11.11	2.27
Very Deficient	0	0	0	0	0
Total	9	44	53	100	100
Category	Average	Good	Good		

According to Table 2, there are 9 children with special needs and 44 normal students. It was observed that 55.56% of children with special needs were categorized as good regarding math self-concept, while 33.33% and 11% were in the average and deficient categories, respectively. These figures showed that the mean math self-concept of children with special needs was in the average category. Meanwhile, 6.82%, 56.80%, 34.10%, and 2.27% of normal children showed very good, good, average, and deficient categories, respectively. Therefore, the average math self-concept showed a good category.

The good math self-concept criteria shown by normal students were describable from several conditions. First, they were actively involved in a class by answering and asking questions as well as participating in voluntary class discussions and activities. Second, most of these students have completed the assignments related to the task. Third, they are confident, and their thoughts as well as beliefs are influenced by feelings/emotions in the classroom. Fourth, they have the ability to learn independently, meanwhile, children with special needs depend on others in order to realize their wishes or desires.

Interview Result

Students with special needs, normal students, and teachers were directly interviewed by asking questions related to numeracy and the learning implementation in inclusive schools. Therefore, the following interview results were obtained:

A student with special needs 1 does not know about numerical literacy, as evidenced by the difficulty in understanding the lesson. When interviewed, the child was still confused since he did not know the meaning of numerical literacy. However, the respondent acknowledged that learning to count was very important. It was observed that this student had difficulty understanding the subject matter and was hesitant to answer the test questions. Also, the respondent was sometimes shy to ask about these difficulties and does not find the learning to be interesting.

Furthermore, a student with special needs 2 likewise knew nothing about mathematical literacy and numeracy as the child still experienced learning difficulties and was confused about numeracy in relation to mathematical ability. It was

observed that the student's siblings often help in doing homework. This respondent also considers learning to count in school as important and always called teachers for assistance when having difficulties in class.

A student with special needs 3 opined that numeracy is learning related to counting. According to this respondent, the ability to count was essential for students. He can learn mathematics independently but lacked self-confidence, as evidenced by the hesitation to answer questions. This student considered learning to count at school enjoyable because he was able to solve math problems. When there were difficulties in understanding the material or questions, teachers provided opportunities for students to ask questions. According to this child, counting often helps in solving daily life problems. The question and answer method make it easier for students to understand the material, while video learning media is preferred by children with special needs.

Normal student 1 does not understand the mathematics concept based on the understanding that the subject is only about numbers and counting. The respondent, therefore, has difficulty understanding the lesson and was also confused about numeracy meaning but acknowledged that learning to count was very important. Furthermore, the child said every confused student was often given the opportunity by teachers to ask questions during the lesson. Learning to count at school was considered interesting because teachers made sure students understood it better. This respondent also said that sometimes she had difficulty following the lesson and asking teachers, while for the homework, she was assisted by her mother and also the tools/media used at home, namely the abacus.

Similarly, normal student 2 knew nothing about mathematical numeracy but understood that numeracy skills are very important to be mastered. This student was able to work independently during learning activities and was confident when answering questions with a belief that the answers are correct. The counting lesson was considered an interesting learning activity due to the perceived challenges, and when facing difficulty in understanding the material, teachers provided opportunities for students to ask questions. Also, when having difficulty doing homework, this student immediately asked the parents and family members for help. This respondent argued that the ability to count helps in solving everyday problems but was yet to realize the preferred learning model for a better understanding of the material, hence, he preferred to use concrete learning media.

It was also observed that normal student 3 was confused about numeracy definition. According to this respondent, learning to count is very crucial because it makes mathematical questions easier to answer. It is also considered exciting as it develops numerical skills. The student was able to learn mathematics independently and has confidence in answering. Students were also permitted to ask questions when they did not understand the lesson. It was further discovered that the average students who struggled with doing homework attempt to solve problems by browsing or asking for help from their closest friends or parents. In addition to being important for students, numeracy skills are also useful in solving daily problems. This respondent explained that the learning model using games and media in the form of pictures is entertaining and easy to understand.

In an interview with Teacher 1, who was a 5th-grade elementary school educator, it was observed that numerical literacy for children with special needs was related to numbers, and included a story, geometry, and algebra questions. These student categories have excellent reading skills but have problems in understanding. This is the reason teachers always assess their math self-concept development, facilitate class participation, and sometimes give students assignments. Even though teachers not comprehensively understood the math self-concept, they still give relevant daily problems to children with special needs using a similar concept as normal students. They facilitate learning by providing opportunities to ask questions and guiding students individually by approaching their desks to explain the material. After they understand, teachers give questions with the same model to examine students' understanding.

In line with Teacher 1, Teacher 2 also stated that numeracy for children with special needs was something related to numbers, including a story, geometry, and algebra questions. The teacher explained the concept of questions given to children with special needs and normal students as the same but with a more simplified nominal, according to their abilities. The teacher similarly facilitates learning by providing opportunities to ask questions and approaching their desks individually to explain the material. After students understand, the teacher gives questions with the same model to test their understanding. The obstacles experienced by teachers are the lack of school facilities, such as LCD projectors for delivering material, students' ability to understand learning materials, environmental factors, and a lack of self-confidence in students. According to Teacher 2, the factors influencing these obstacles were teachers who have not mastered technology, students, and the environment. To overcome these obstacles, the teacher asked for the parents' cooperation in guiding the students.

The teacher considered learning design to be very important when carrying out learning since it affects student learning outcomes. This means a neatly arranged learning design tends to produce good quality learning. However, the curriculum between regular students and children with special needs has not been separated. Teachers also have not or rarely used learning media when delivering material. The e-module learning media is very good for students and this is the reason the school has also compiled or planned to make a chrome book in order to facilitate students in exploring learning materials individually.

Discussion

This study's results showed that the numerical literacy of children with special needs in inclusive primary schools was in the very deficient category, while the math self-concept was average. Also, the normal students' numeracy was deficient with math self-concept being categorized as good.

In the learning process, teachers do not understand the appropriate treatment for children with special needs and normal students. Treatment in child-friendly learning is carried out by special companion teachers. For collecting data and information on child-friendly learning that is carried out in inclusive schools based on learning carried out by special accompanying teachers. According to a special assistant teacher, students who were slow in learning took longer than the normal ones. The characteristics of slow students in high grades include not being able to read, slow in doing assignments, difficult to distinguish shapes, and slow in understanding the given material. Concluded that teachers need to note and mention each student's progress in the learning process (Zeidmane & Cernajeva, 2011).

Special assistant teachers need strategies in guiding both children with special needs and normal students. The child-friendly learning has not been properly implemented, as it has not contributed to supporting and promoting numeracy and math self-concept of students with special needs. The strategy also includes fixing the sitting position of children with special needs by placing them in the front row. Teachers are expected to observe the students' conditions, give feedback to both the teacher and students and then reward them with praise, applause, and motivation. In addition, teachers need to give special additional lessons outside of other subjects that have to be performed after ending the class.

There are three factors affecting the numerical literacy level that special assistant teachers need to consider. The first and second factors were identifying expected student changes and selecting an appropriate teaching and learning approach. The third is selecting the most appropriate and effective teaching procedures, methods, and techniques. The three kinds of learning methods useful for the slow students category include the lecture, question-and-answer, and discussion methods. Teachers mostly use the lecture method to explain the material presented because the gap between the subject matter and students' real-life math experience, as well as the lack of mathematics application, hinders student learning (Kao, 2021).

The lecture method in an inclusive class is combined with activities since the explanation given leads to practice, which helps the teachers in providing and comparing concrete objects through directions based on the ability of children with special needs. This concept is regarding teaching methods of creating and innovating new ideas that promote learning among modern learners and also respond directly to their learning experiences (Chatwattana, 2021). Furthermore, the lecture method is used in a conventional learning process, meaning that there is no constant contact between the teacher and students, thereby making it more focused on delivering material in one direction. Based on the observational results, special assistant teachers control the class more through this method compared to others.

Furthermore, child-friendly learning in inclusive primary schools requires group discussions involving two methods that are combined by the teacher in one lesson. It begins with teachers facilitating learning activities and then continues by forming groups for discussion. Teacher divide students into several groups without distinguishing between those with special needs and high intellectual abilities. Afterward, each group was expected to present their discussion results in front of the class. This model is considered as significant for students (Karahoca et al., 2022). Normal students and children with special needs hold a two-way contribution that facilitates each other. According to inclusive teachers, the group discussion method helps children with special needs to learn from their friends or peers, thereby covering each other shortcomings. The framework begins by considering students' conditions, particularly those who need various types of learning support, and incorporating their needs into the design of curriculum, materials, methods, and environments in order to support access, participation, and progress for each student (Griful-Freixenet et al., 2021).

It was observed that children-friendly learning to facilitate numeracy and math self-concept in inclusive primary schools has not been implemented. Also, handling children with special needs requires sufficient knowledge and skills, indicating several aspects need to be considered when implementing children-friendly learning. The first is to recognize that, unlike others, children need many repetitions in order to understand the material. The second is to provide tutorial activities both at school and home, while the third deals with using demonstration methods and visual cues in order to avoid verbalism. The fourth is to teach simple concepts at the beginning of learning to understand the next lesson and the fifth is simplifying the instructions, while the sixth is to identify students learning styles, whether visual, auditory, or kinesthetic.

In dealing with children with special needs, several things need to be done in child-friendly learning in inclusive schools by special accompanying teachers, among others (a) understanding the children's characteristics; (b) knowing the children's character; (c) applying certain methods to children who are slow to understand the lesson; (d) providing a seat that allows the student to hear the teacher's explanation more clearly; (e) selecting a seatmate who is intelligent and has social care; (f) providing additional assignments/homework in the form of text or reading assignments; and (g) consulting with the child's parents.

Students' success in Elementary Schools is measured by the achievement of minimum completeness criteria standards. In the special programs for children with special needs, the agenda included is an assessment, and the evaluations used by high-grade teachers are directly given to detect the proper practice of students. Teachers assess the business development and learning outcomes of children with special needs, particularly in literacy, through observations of ongoing learning activities both individually and in groups in the classroom (Lin, 2021).

The qualitative data results revealed that there is a relationship between students' numeracy and math self-concept. It was observed that as the numeracy category becomes better, the math self-concept also improves. Another result showed that not every inclusive school has special assistant teachers, even though they are needed in inclusive learning. This is reinforced by the fact that there are only 2 special assistant teachers from seven inclusive schools. Meanwhile, every school is expected to have at least one special assistant teacher. This is a warning for institutions and policymakers to be more cautious when implementing inclusive schools.

Conclusion

The conclusions of this study include: (1) the factors influencing the numeracy level that special assistant teachers need to consider, and it entails the identification of expected student changes, selection of appropriate teaching and learning approaches, and selection of the most appropriate and effective procedures, teaching methods, and techniques. (2) Children-friendly learning has not been properly implemented as it has not supported and facilitated students' numeracy in inclusive Elementary Schools. (3) There is a relationship between students' numeracy and math self-concept, i.e., as the numeracy category becomes better, the math self-concept also improves.

Recommendations

An opportunity for future work is the importance of numeracy literacy in inclusive primary schools. It requires learning media development to facilitate, manage and implement new learning designs. Recommendations for practitioners are expected to be able to provide attention and more special assistance outside of class hours, so students have the opportunity to convey obstacles experienced or get the opportunity to add students' understanding related to the material that has been delivered on when learning activities take place

Limitations

Ideally, every inclusive school should have at least one special assistant teacher since their presence is required in the learning process. In this research, not every school has special assistance instructors, limiting the amount of data that may be extracted.

Authorship Contribution Statement

Danuri: Conceptualization, design, analysis, writing. Waluya: editing/reviewing, supervision. Sugiman: editing/reviewing, supervision. Sukestiyarno: editing/reviewing, supervision

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