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Cognitive Development of Elementary School Children in Developing Critical Thinking Ability and Understanding Mathematical Concepts

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ABSTRACT
This study aims to determine students' cognitive development in developing critical thinking skills and understanding mathematical concepts at the elementary school level. This study uses qualitative methods with convenience sampling techniques. The researcher collected the data through interviews with six elementary school students from grades 3 to 5 on May 2023. They are inhabitants of Tegal Gundil, Bogor. Some of the problems identified include the inability to answer random questions, inappropriate questions and answers, disobedience in understanding the teacher's explanation, and external factors hindering elementary school children's cognitive development. Based on these problems, this study found that cognitive development is essential in developing critical thinking skills and understanding mathematical concepts in elementary school-age children. Suggestions include using an inclusive learning approach, adjusting questions and answers, increasing the ability to understand teacher explanations, and collaboration between schools, parents and the community. With the right approach and adequate attention, students can improve their cognitive development by developing critical thinking skills and understanding mathematical concepts.

Keywords:
cognitive development; critical thinking; elementary school children; understanding of mathematics

INTRODUCTION

Development is a psychological change experienced by every human being who will later experience an increase or progress in maturity (Khaulani, 2020). Cognitive is a psychological part which includes cognitive behaviour in terms of the ability to consider, solve problems, understand, and process information, stability and wilfulness, so cognitive can be interpreted as academic psychology—individuals related to the knowledge possessed.

Knowledge of human development is fundamental to know and understand as a guide in understanding a person's needs and character, including elementary school students. Understanding the development of elementary-age children is a must for parents. Given that elementary-age children do not yet have maturity in thinking, children have limitations in sorting and choosing something that is positive or negative and which one has a good or bad impact.

One aspect that is very important to know and understand from the development of elementary-age children is the cognitive aspect. Cognitive development is a comprehensive development related to thinking skills, such as the ability to reason, remember, memorize, solve real problems, have ideas and creativity. Cognitive development influences children's mental and emotional development and

language skills. Children's Attitudes and actions are also related to their ability to think children. Thus, cognitive development is the key to non-physical development.

The cognitive development of elementary-age children certainly cannot be equated with the cognitive abilities of adolescents and adults. In general, the cognitive abilities of elementary-age children are still limited in concrete and real matters; for example, children aged 6 or 7 years can understand that glass can break when hit on the floor, but children cannot scientifically answer the cause of the broken glass. Elementary-aged children have limitations in thinking about abstract things. For example, children aged 7-9 thought about why the Earth revolves around the sun. Children will experience difficulties and even feel confused about answering such questions scientifically. When forced, children will feel stressed because their cognitive abilities have not yet reached the stage of complex thinking.

Cognitive, or intellectual, is one aspect of development in relation to the intellectual abilities possessed by each individual, namely the intellectual potential in the ability to think and solve problems (Latifa, 2017). Piaget's theory of cognitive development is a hypothesis explaining how children adjust to and describe events around them. Piaget also classifies the systems and cycles of human intellectual improvement from the initial stages of human thought from adolescence to maturity. The purpose of cognitive theory regarding intellectual development by Piaget is to explain various things that can affect the ability to think to develop (Khiyarusoleh, 2016). Education is a lifelong process of self-development in various environments, such as family, school, friends, and society.

The cognitive development of elementary school children significantly impacts the development of critical thinking skills and understanding of mathematical concepts. Research by Rivas, Saiz, & Ossa (2022) shows that metacognitive strategies can improve students' ability to apply mathematical logic and identify patterns in complex mathematical problems. Meanwhile, research by Warsah, et. al. (2021) found that collaborative learning is essential in developing critical thinking skills and understanding mathematical concepts through social interaction with peers. A longitudinal study by Thompson (2013) shows that students' cognitive development progress is positively related to their ability to understand more complex mathematical concepts. Research by Larbi & Mavis (2016) highlights the importance of using manipulatives, such as physical objects and visual representations, in promoting critical thinking and understanding of mathematical concepts in elementary school students.

Cognitive development is significant for students and influences their learning and success. Teachers play an essential role in understanding students' cognitive development and provide learning according to their abilities. Cognitive development allows students to master broad general knowledge, interact with the surrounding environment, and determine how quickly a problem can be solved (Fitria, 2021). Critical and creative skills are essential components that students must possess in the 21st century, as stated in the 21st-century competence 4.0. Learning in the 21st century does not only explain the material but rather provides meaningful learning so students can master critical, creative, thinking, and process skills (Jufri, 2013).

According to Law No. 20 of 2003 concerning the National Education System, Article 1 paragraph (6) reads, "Educators are academic staff qualified as teachers, lecturers, counsellors, tutors, instructors, facilitators, and other designations appropriate to the speciality and participated in organizing education". Thus, it is clear that the teacher has an important task and role in learning activities in the classroom. Sometimes teachers treat their students less according to the abilities of students. Equal treatment between students without looking at the potential and learning style of each will have an uneven effect on student achievement in learning (Aaliyah, 2020).

One of the activities in mathematics that can develop students' conceptual understanding and critical thinking skills in learning mathematics is exploratory learning activities. Exploratory learning activities are activities to explore ideas, arguments and different ways from students through several open questions and instructions so that they can lead students to understand a concept and solve problems. In this activity, students become active explorers, and the teacher is a facilitator. Explorative learning is by constructivism theory. Constructivism is the process of building or compiling new knowledge in students' cognitive structures based on experience (Masitoh, 2016).

The stages of the exploratory learning approach consist of four stages. Among them are (1) Presentation of exploratory problems; (2) Collection of data and information; (3) Data analysis; (4) Presenting results and conclusions reports (Khaerunnisa, 2013).

Factors that inhibit the cognitive development of first elementary school children genetic/heredity factors are internal factors that influence individual growth and development. Heredity itself is the totality of individual characteristics inherited from parents. In line with that, genetic factors can become potential (both physical and psychological) possessed by individuals since the prenatal period as an inheritance from parents through genes (Latifa, 2017). From this definition, this factor is potential, inherited and natural (nature).

Second, environmental factors (nurture), the environment is an external factor that also shapes and influences individual development (Taufik, 2019). As previously explained, genetic factors are potential, and the environment will make them actual. Several environmental factors are very prominent in the family environment. According to Latifa (2017), the reasons for the critical role of the family in child development are:

1. The family is the first social group at the centre of child identification.
2. The family is the first environment that introduces the values of life to children.
3. Parents and family are "significant people" in developing a child's personality.
4. The family is an institution that facilitates essential human needs, both biologically fictitious and socio-psychological.
5. Children spend much time in the family environment.

The cognitive development of elementary school children in developing critical thinking skills and understanding mathematical concepts has a critical urgency. As part of the teaching and learning process in elementary schools, the cognitive development of elementary school children affects their ability to understand mathematical concepts. Elementary school children with good critical thinking skills

can solve math problems more easily and quickly. In addition, the ability to understand mathematical concepts is also essential because it is the foundation for learning more complex mathematics at a higher education level. Therefore, research on the cognitive development of elementary school children in developing critical thinking skills and understanding mathematical concepts is fundamental to improving the quality of learning in elementary schools.

Students encounter several problems in the process of learning mathematics in elementary schools, such as not being able to answer random questions given by the teacher, there were discrepancies in the questions and answers generated by students, the ability to understand the teacher's explanations in one class was inconsistent, and there were factors outside of school that impede the cognitive development of elementary school children. Therefore, research focusing on these problems will help teachers and stakeholders in the world of education to develop strategies and learning methods that are more effective in improving the cognitive development of elementary school children. The results of this research help teachers better understand the challenges students face in understanding mathematical concepts and also help students develop better critical thinking skills.

METHOD

This study used a qualitative approach using interview and observation techniques as data collection techniques. The population of this research is elementary school-age children who attend schools in Tegal Gundil, Bogor. The sample was selected by convenience sampling, often called accidental sampling. Convenience sampling is when the researcher selects the most accessible or available individual or subject to be sampled in the study. In convenience sampling, convenience and sufficient availability regarding cognitive development and critical thinking abilities are used to select the sample. Interviews were conducted in a structured manner in May 2023 using a pre-prepared list of questions. Researchers use a narrative technique to analyze the qualitative data obtained, which involves building a coherent narrative or story from the qualitative data. This technique will explain the relationship and context among various themes or events that emerge from the data.

RESULTS AND DISCUSSION

Result

There were six people as an informant. For the first question, the researcher asked elementary school-aged children about their preference for mathematics. Researchers got three variations of different answers. There are four children with the initials HA, FU, RA, and CH loudly answering that they do not like math. When asked by researchers the reason why they do not like mathematics, they answered,

"*I do not like it because math makes a headache, especially about division.*"

"*I do not like word problem questions because the questions are too long.*"

Then, there are differences in answers to children with the initials FI. Where FI said she did not have a significant dislike, but that did not mean FI liked mathematics. FI feels easier to finish questions with daily life-related stories. These differ from what HA, FU, RA, and CH said. The last child, DH, had a different answer. This child even

answered that she liked math. However, unlike FI, DH prefers questions in the form of direct mathematical operations, not in the form of word problems. DH said,

"*The non-word problem questions are easier because the teacher has explained them directly.*"

In continuing the interview session, the researcher asked the elementary school-age children about how they faced exams in mathematics, as well as how confident these elementary school-aged children were in the exams they would face. Researchers get many variations of answers this time. All elementary school-age children answered that they would seriously study to face the math test they were about to face. However, there are differences in each child's confidence level in facing math exams. Children with the initials HA, RA, CH, and FI said they had no confidence even though they had tried to study for the exam they were facing. Where FI said,

"*Sometimes, even though I have studied, I cannot answer the questions.*"

This response is different from DH, who feels confident about herself to face exams with the learning results she has done. Apart from DH, FI also feels confident about facing the test. DH clearly states,

"*Usually, the exam is not far from what is in the book.*"

In this case, DH teachers can get their students to learn well. So with that, the children will get satisfactory grades with the compatibility between the material.

The variety of answers that the researchers got from the elementary school-aged children that the researchers interviewed. There was a particular interest for the researcher to continue the interview session with good questions related to the learning activities of elementary school-age children at school and at home. The researcher asked whether elementary school-age children received additional tutoring outside of the learning activities that elementary school-age children did, and the answers obtained by researchers are interesting. At the same time, most elementary school-age children answered that they did not get additional tutoring. CH, the child in the previous question, said that he did not like math and did not even have confidence when the math test; he got additional math tutoring from CH's parents.

"*Yes, I have math lessons. My mother asked me to.*"

There is a different concern from CH's parents, who know that their children do not have the confidence to study independently in the face of math exams. So the shortcut chosen by CH's parents was to add math tutoring for CH. With hope, CH will have better confidence in facing the next math exam.

The next researcher asked questions about their understanding of the explanations given by their respective teachers. Elementary school-age children answered dominantly that the teacher's explanation was sufficient to be understood in every material. The researcher continued this question by asking about the activeness of elementary school-age children, whether to immediately volunteer in all forms of participation expected by the teacher or to allow other friends to do so. These two questions are related at once so that researchers get several variations of answers from elementary school-age children.

"*I understand, but if, for example, the teacher asks me, I will just let the others answer.*"

From the answers submitted by RA and CH, the researcher found that some elementary school-age children still lacked the confidence to answer questions posed by the teacher as a form of activity and allowed other children to answer even though RA and CH knew what the answers were. However, this is different from FI with the answers given,

"I will answer it if I know the answer."

The answer that the researcher got is quite interesting because FI, which is already in a higher class with RA and CH, has a further development, where the self-confidence possessed by FI is better and follows learning to the fullest by participating in all forms of activity provided by the teacher, such as being spontaneous in answering questions.

As an additional question to see how the critical thinking skills of elementary school-age children are in everyday life, the researcher proposes a case. If students are in a situation where the bicycle they are riding breaks down, what will they do? Ask friends for help, or try to push the bike home themselves. Of course, to this question, there are differences in the answers given by children of primary school age.

However, there were not many differences; almost all primary school-aged children interviewed chose to push their bicycles in case of a breakdown. There is a form of responsibility for each elementary school-age child in dealing with their problems. In contrast to CH, who prefers to ask for help from CH's friends if the bike he is riding has some problems.

"Once, at that time, my bicycle chain broke because I was with my friend. I asked him to fix my bicycle first."

Once CH answers, CH has a random pattern of thinking. Asking for help from his friend, who was with CH then, was a quick step to solve CH's problem. With these questions at the end, the researcher completed the interview session with elementary school-age children. The results obtained by the researchers are satisfying expectations and running smoothly.

Discussion

Based on the interviews conducted, we found several problems relevant to elementary school children's cognitive development in developing critical thinking skills and understanding mathematical concepts. The first problem is the need for elementary school children to answer random questions given by the teacher. This action can maximize children's cognitive development, which needs to be optimized in processing information quickly and giving appropriate responses. According to Piaget's theory of cognitive development, children at primary school age are still in the concrete operational stage, where they can better understand concrete concepts than abstract ones.

The next problem is the discrepancy between the questions posed by the teacher and the answers produced by the students. This problem shows that students need to understand the questions thoroughly, or there may be difficulties applying their mathematical knowledge. In this case, the teacher needs to use a more straightforward and structured teaching approach and provide relevant examples so that students can understand well.

Inequality in understanding the teacher's explanation in one class is also a problem. This problem may be due to various factors, such as differences in students' understanding levels, limited learning time, or a lack of appropriate teaching approaches. In this context, teachers need to use interactive teaching methods, provide opportunities for each student to ask questions and adopt learning differentiation strategies that can adapt to individual student needs.

In addition to problems directly related to the learning process at school, it is also necessary to pay attention to factors outside of school that hinder the cognitive development of elementary school children. The family environment, as children's immediate environment, can significantly influence their cognitive development. Suppose a child spends much time in a family environment that is less cognitively stimulating, such as minimal verbal interaction or lack of access to educational materials. In that case, this can hinder the development of critical thinking skills and understanding of mathematical concepts.

In addressing these issues, cognitive development theory can provide helpful guidance. Teachers can adopt learning approaches that are appropriate to the stage of cognitive development of elementary school children, such as providing a concrete understanding of concepts and relating them to real situations. In addition, involving parents in the learning process is also essential by providing cognitive support and stimulation in the family environment. Thus, the research results on the cognitive development of elementary school children in developing critical thinking skills and understanding mathematical concepts can provide a better understanding of the challenges students face and help improve the quality of learning in elementary schools.

CONCLUSION

Based on the interview results, cognitive development is vital in developing critical thinking skills and understanding mathematical concepts in elementary school-age children. This skill triggers several problems, including difficulties in answering random questions, discrepancies in questions and answers, an uneven ability to understand teacher explanations, and factors outside school that hinder cognitive development. Therefore, efforts are needed to improve critical thinking skills and understanding of elementary school children's mathematical concepts through learning approaches appropriate to individual learning styles, emphasizing the in-depth understanding of concepts and collaboration between schools, families, and communities.

Several suggestions can improve the cognitive development of elementary school children in developing critical thinking skills and understanding mathematical concepts. First, teachers need to adopt an inclusive learning approach. Every child has a different learning style, and teachers must know this. By using a variety of teaching methods that cover a variety of learning styles, such as hands-on experience, problem-solving, and group discussions, teachers can provide opportunities for each child to develop their critical thinking skills. Second, it is necessary to adjust the questions and answers elementary school students submit. The teacher must ensure that the questions asked to students are appropriate to their level of understanding. If a

question is too complex or straightforward, students may need help giving the correct answer.

Third, efforts are needed to improve students' understanding of the teacher's explanation in one class. In a diverse class, some students may need help understanding the explanation given by the teacher. Therefore, teachers must use various teaching strategies, such as pictures, concrete examples, or more straightforward language, to ensure that each student can follow the lesson well. Finally, it needs to be recognized that factors outside of school can influence the cognitive development of elementary school children. Children sometimes face challenges and obstacles in their environment, such as a lack of family support, an environment that is not conducive, or social-emotional problems. Therefore, collaboration between schools, parents and the community is essential. By implementing these suggestions, students can improve the cognitive development of elementary school children by developing critical thinking skills and understanding mathematical concepts. An inclusive learning approach will ensure that every child gets a fair opportunity to learn and develop according to their potential.

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