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The Analysis of Difficulties in Logical Thinking Ability in Learning Natural Science Faced by Students of Elementary Education

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Abstract: Logical thinking is analyzing a situation and coming up with a reasonable solution. It is crucial because it can help a person reason through crucial decisions, solve problems, generate creative ideas, and set goals to be achieved, all of which are needed to develop self-competence. This study aims to explain students' difficulties in logical thinking ability in elementary education on a natural science course. This study is qualitative using the literature review technique about students' difficulties in logical thinking. The results of the analysis have shown that the difficulties faced by students in developing logical thinking ability are in determining alternatives for the problems given; choosing and solving problems in natural science given by lecturers, and in students to understand. The causes of students having difficulties in developing logical thinking are not used to solving problems in natural science that need logical thinking. In addition, students are less creative in choosing or looking for the right strategy for the problems given. Finally, students are less thorough in solving problems in natural science.

Keywords: Logical thinking; Natural science; Elementary educations

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Introduction

In recent years, the implementation of the 2013 curriculum has changed the orientation of learning, which initially tends to focus on achieving student competence through various teacher activities (teacher center) to a learning focus that focuses on the learning process carried out by students (student center). Competence achievement also experienced an increase which initially focused on achieving lower-order thinking to higher-order thinking. Higher-order thinking skills require students to be able to analyze and make problems solving with increasingly higher levels of complexity. Critical thinking skills (Malik et al., 2020; Malik & Ubaidillah, 2020), creative thinking (Malik et al., 2019a; Hasibuan et al., 2022), problem-solving (Nuryantini et al., 2020; Malik et al., 2019b), communication (Dannels et al., 2003; Malik & Ubaidillah, 2021a), and collaboration (Wang et al., 2015; Malik & Ubaidillah, 2021b) and logical thinking skills are some of the higher-order thinking skills needed.

Based on careful considerations, logical thinking is essential to support learning development (Ramirez et al., 2019). Logical thinking will be able to describe the scientific abilities of students. Logical thinking occurs when explaining why and how a result is obtained, how to conclude from the available premises, and how to draw conclusions based on specific inference rules. The form of activity that is broader than the ability to think logically in solving problems is reasonable (McLeod, 2015). Logical thinking is the essential ability to think accurately based on available spaces. Developing logical thinking is essential in order to

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understand scientific concepts. The lower the student's logical thinking ability, the lower the understanding of scientific concepts. A study that examined the comparison of logic tests on students who had examination results in science proved it.

The Test of Logical Thinking (TOLT) showed that only 23.3% of the students reached the concrete stage, 53.3% of the students reached the transition stage, and 23.3% of the students reached the formal stage. This study also showed a positive correlation between logical thinking and understanding scientific concepts. The higher students' logical thinking scores are, the higher students' understanding of scientific concepts. Students of elementary education in natural science courses are expected to demonstrate the ability to solve problems logically according to the indicators of logical thinking. The students also must understand problems, arrange plans and make arguments, execute plans well, re-examine the results of the problems solving and draw the conclusions well (Octaria, 2017; Lusidawaty et al., 2020).

Logical thinking ability is very much needed for students, especially the students of elementary education, so that when they later enter the world of work, they will be able to overcome and solve the problems they face. In fact, in natural science learning courses, the students still have difficulties solving problems related to logical thinking (Marta et al., 2020; Aminudin et al., 2016). They have less understanding of the matter of logical thinking ability terms of some indicators: the ability to define the problems in natural science, the ability to choose relevant information to solve the problems, the ability to develop and choose relevant hypotheses, and the ability to make conclusions from the problems given. Accordingly, the researcher sought to analyze students' difficulties in logical thinking in the natural science course

Method

This study uses the method of writing a literature review (Creswell, 2014). The literature review in this study is about the difficulties in logical thinking-based learning. The literature sources used in this study can be obtained from reading, analyzing, taking notes, and processing them. In this study, the data obtained are sourced from secondary data sources. According to Sugiyono (2013), secondary data sources are the sources of data that are not obtained directly by researchers; instead, the researchers obtain the data from other people. In this study, journals that correspond to the theme that the researcher wants to examine are also taken. This study takes references to journals literature in the forms of classroom action research and quantitative and qualitative research. The research proceedures is shown in Figure 1.

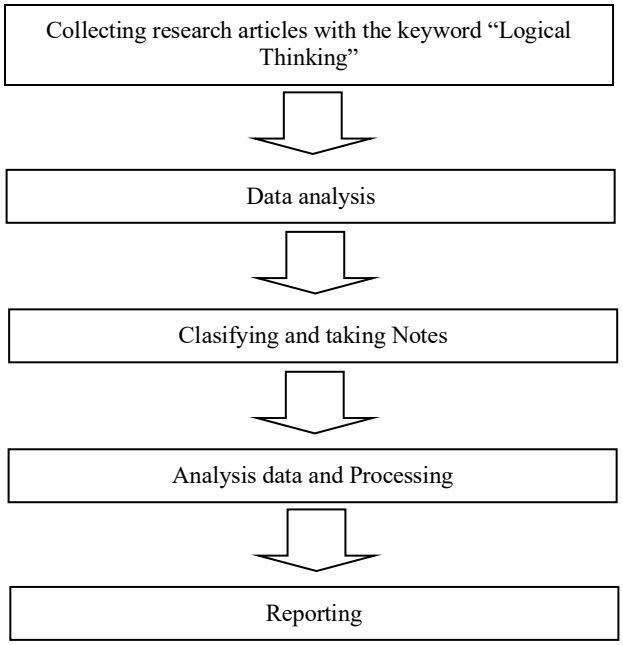

Figure 1. Research Proceedures

The data collection technique used findings of difficulties in logical thinking (Sugiyono, 2013). The findings in the literature review are used to describe the difficulties experienced by students in problem solving-based learning.

Result and Discussion

Results

Logical thinking is related to complex decision-making and problem solving (Fitria et al., 2019). These two activities are often found in daily life, for instance, deciding the direction to be taken in order to avoid a traffic jam (decision making) and finding a strategy when you are stuck in a traffic jam in order not to be late to attend a particular meeting (problem-solving). Logical thinking ability is the ability to use statements in the form of ideas to be analyzed systematically. Individuals who think logically will express their ideas and opinions in structured words so that the reasons put forward become proper arguments. Students' logical thinking is directly proportional to their analyzing ability. Students' excellent analyzing ability will result in their excellent logical thinking ability. By thinking logically, students do various exercises in the form of problems related to natural science as the application used to improve their logical thinking ability. The characteristics of logical thinking ability have similarities with logical reasoning. One of the characteristics of logical thinking ability is the ability to make a generalization and causal relationship, while the characteristics of logical reasoning include making a generalization and drawing a logical conclusion based

on inference rules (Diana, 2018; Moma, 2017). The characteristics of logical thinking and logical reasoning are similar in making a generalization and drawing logical conclusions.

The reasons stated above do not mean that logical thinking and logical reasoning are two same meanings. Logical thinking has a broader understanding than logical reasoning because logical thinking includes logical reasoning activity, and other thinking abilities. Understanding, making mathematical connections and mathematical communication, and solving problems logically are the abilities included in logical thinking (Sumarmo et al., 2012). Logical thinking ability is based on the theory of mental development from Piaget. This mental development theory is to distinguish students from the stage of concrete operation to formal operation (Octaria, 2017). The measuring instrument used is the Test of Logical Thinking (TOLT). The questions in the TOLT measure five abilities, namely: 1) Controlling variable: the ability to interpret information as a controller so that other things influence the relationship between independent and dependent variables; 2) Proportional reasoning: students' ability to determine quantity based on the proportion given; 3) Probabilistic reasoning: students' ability to determine the probability of occurrence of a particular event; 4) Correlational reasoning: the ability to draw conclusions based on the reciprocal relationship of the statements given; and 5) Combinatorial reasoning: the ability to determine all possible alternatives in a particular event.

Several other experts also mention the definition of logical thinking. Logical thinking or sequential thinking is defined as the process of reaching conclusions using consistent reasoning, causal thinking, and pattern-based thinking (Agustina & Farida, 2019) or logical inference rules or logical principles to obtain conclusions, and thinking which includes induction, deduction, analysis, and synthesis (Ramirez et al., 2019).

Adversity quotient is the intelligence that underlies a person's success in facing a challenge when there is difficulty or failure. Everyone desires a successful life. However, they have not realized that the capability to be successful depends on the individual. It relates to the strength of personality and capability to respond and face a challenge in life. According to Rosita & Nopriana (2016) a person's success is mainly determined by the level of adversity quotient. The adversity quotient is manifested in three forms: 1) A new conceptual framework for understanding and improving all facets of success; 2) A measure to determine a person's response to adversity; 3) A set of tools to improve one's response to adversity.

Based on the elaboration above, it can be concluded that the adversity quotient is an individual's ability to survive all kinds of difficulties until finding a way out, solving various problems, and reducing obstacles by changing the way of thinking and attitudes towards these difficulties (Sari et al., 2019). There are three groups of people categorized according to their ability in response to adversity.

a. Quitters

Quitters are people who choose to leave, avoid obligations, back off, and quit when facing difficulties. This type of person stops in the middle of the process and quickly gives up. Quitters are often satisfied with fulfilling basic or physiological needs, and they tend to be passive. Besides, they choose to leave to avoid the process, retreat, and stop. Quitters do not accept the opportunity that comes with challenges and obstacles. Therefore, they often miss many valuable opportunities in life. In Maslow's hierarchy, a quitter is at the bottom of a pyramid which is a fulfillment of physiological needs.

b. Campers

This group is satisfied with self-sufficiency and does not want to develop themselves. It is a slightly larger group that seeks to meet the needs of safety on Maslow's hierarchical scale. The people in this group do not have a high desire to change because they are driven by fear and only seek safety and comfort. Campers have at least stepped up and responded to the challenge, but after reaching a particular stage, campers stop even though there is still a chance to develop even more. Unlike quitters, campers have at least responded to the challenges they face to reach a certain level.

c. Climbers

Climbers are always optimistic. They see opportunities, gaps, and hope behind decisions and are always eager to move forward. Small dots are taken for granted. Climbers can be considered a shining light of success. Climbers always try to reach self-actualization, which is at the top of Maslow's hierarchical scale. They fight their whole life, no matter how great the difficulties are. The environment does not control climbers; yet, they control the environment with a variety of creativity.

Moreover, they will always think of various alternative problems and consider the difficulties and obstacles that exist as opportunities to advance, develop, and learn more about adversity in life. They will always be ready to face various obstacles and challenges caused by changes. Offers four basic dimensions that will result in high adversity quotient ability (Fitria et al., 2013), namely:

1. Control (C)

Control relates to how capable people control the adversity they face and to what extent they know that control plays a role in the events that cause adversity.

Thus, the greater the control owned, the more likely a person to be able to survive and determined in finding solutions. On the other hand, when the control is likely lower, a person becomes helpless and gives up quickly.

2. Ownership (O)

Ownership, also called origins and recognition, will question who or what causes the adversity and to what extent an individual perceives themselves as the influence of themselves, which becomes the origin cause of adversity. People with low origin scores will think that all adversities or problems are due to their own mistakes, carelessness, or stupidity, which will destroy their spirit.

3. Reach

Reach is part of the adversity quotient, questioning the extent to which the difficulties reach other parts of the individual or one's life. It shows people's ability to assess the workload that causes stress. When a person's reach is higher, they are more likely to respond to adversity as something specific and limited. On the other hand, when a person holds back the reach, the person will be more empowered and feel hopeless or unable to distinguish things relevant to the difficulty will be reduced.

4. Endurance

This dimension is related to one's perception of how long the adversity will last. Endurance can lead to judgments about ideal or harmful situations. Someone with high endurance will have hope, and an optimistic attitude in overcoming the difficulties or challenges faced. The higher the endurance the individual owns, the greater their mindset in viewing success as something temporary. On the other hand, people with a low adversity quotient will assume that the adversities that they are facing are eternal and firm.

Discussion

Logical thinking skills are essential because they can help a person reason through crucial decisions, solve problems, generate creative ideas, and set goals — all of which are necessary to develop a career. There are many ways to strengthen logical thinking in daily work. Here are some methods that can consider developing logical thinking skills: (1) Make time for creative hobbies, (2) Practice asking questions, (3) Socializing with others, (4) Learn new skills, (5) Try to anticipate the outcome of your decisions. The ability to think logically is needed by individuals when they are active in making decisions, drawing conclusions, and solving problems. The activities carried out can be related to mathematical problems or problems found in everyday life. Another activity that individuals do in logical thinking is explaining why and how a result is obtained, how to conclude from the available premises, and conclusions based on specific inference rules—a broader form of activity than the ability to think logically in solving problems sensibly. According to Sumarno, et al., (2012) and Fardiana, et al., (2019), the ability to think logically includes the ability to: (1) draw conclusions or make estimates and interpretations based on appropriate proportions, (2) draw conclusions or make estimates and predictions based on opportunities, (3) Draw conclusions or make estimates or predictions based on a correlation between two variables, (4) Determine the combination of several variables, (5) Analogyis to draw conclusions based on the similarity of the two processes, (6) Doing evidence, (7) Prepare analysis and synthesis of several cases. Seven indicators can be simplified into (Hidayat & Sumarmo, 2013; Bakhy et al., 2018): (a) conclude analogies, generalizations, and constructing conjectures, (b) draw logical conclusions based on the rules of inference, checking the validity of arguments, and compiling valid arguments, (c) compiling direct or indirect evidence.

Figure 2. Student Activities

The results of research by Effendi et al., (2017) found that students' logical thinking abilities on each indicator, concluded that: (1) Ability to draw conclusions or make estimates and interpretations based on the appropriate proportion in the low category (mean 22.50), (2) The ability to draw conclusions or make estimates or predictions based on the correlation between two variables in the medium category (mean 47.50), (3) Ability to determine the combination of several variables in the medium category(mean 54.99), (4) The ability to perform evidence in the low category (average 33.33), (5) Ability to compile analysis and synthesis of several cases in the low category, (mean 39.17).In general, students are most able to carry out the third indicator, namely the ability to determine the combination of several variables. The most challenging perform the first indicator, namely the ability to draw conclusions or

make estimates and interpretations based on appropriate proportions.

Figure 3. Teacher Activities

Conclusion

Based on the analysis results, there are three difficulties experienced by students in building logical thinking skills. First, students have difficulty in determining alternatives to the problems given. Second, students have difficulty choosing and solving science problems given by the lecturer. Next, science problems are complex for students to understand. Moreover, there are three causes of adversity in building students' logical thinking. The first cause is that the students are not accustomed to solving science problems related to logical thinking. Second, the students are less creative in choosing or looking for the right strategy by problems given. Lastly, the students are less thorough in solving science problems. The suggestion offered to solve the problems in this study is that lecturers should assist students who have adversity in solving problems. They should often be given problems that can foster logical thinking, so they are accustomed to high-level problems.

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