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DEVELOPMENT OF THE CRITICAL THINKING CATEGORICAL SYLLOGISM LEARNING MODEL IN ELEMENTARY STUDENTS

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ABSTRACT

In dealing with the development of society as a technology user, categorical syllogism critical thinking is a skill needed by students starting from primary school. This study aims to find learning methods that develop categorical syllogism critical thinking, as well as developing measuring instruments used to measure these abilities. The research method is quasi-experimentation. The study involved fourth-grade students in two elementary schools in Salatiga totaling 24 students and Yogyakarta totaling 34 students divided into 6 groups. In addition, the research also involved 6 MBKM students who functioned as mentors of each learning group. The activity was designed and conducted based on previous research. The first task includes finding the most appropriate shutter to produce the best photo quality ten times. As for the second task, they were instructed to take 3-5 photos that describe a category. The result of measurement of Categorical Syllogism Critical Thinking showed that categorical syllogism critical thinking learning could increase student engagement in the learning process of critical thinking. Engagement is an important part of the learning process. In addition, based on worksheet data, it was found that the average group managed to find the right answer after 9 tries, and students can assign the right categories for the objects they found. Meanwhile, the measuring device for categorical syllogism critical thinking must be refined to be able to measure changes in critical thinking skill before and after treatment more precisely. Based on this research, this Categorical Syllogism Critical Thinking Learning Model can be a reference for teachers to develop critical thinking learning methods in accordance with the situation and conditions of each school.

Keywords: *Critical thinking, categorical syllogism, adaptation, primary school*

1. PREFACE

In Indonesia, many academics are worried about a thinking skill issue. They are worried that this issue may spread to other aspects of people's lives (Tiatri & Jap, 2015). Critical thinking is a process of thinking with a purpose and discipline and being able to direct oneself to improve the decisions and actions one takes (Amanda, 2022). Not only a thought process with a purpose and discipline, critical thinking is also a vital skill in the 21st century. This refers to students thinking about a series of interrelated critical questions, their ability to ask and answer questions well, their desire to be able to ask and answer questions well, and their desire to be able to take advantage of their critical thinking abilities in solving a problem (Liu et al., 2022) As per the statement above, critical thinking is a vital skill in the 21st century and refers to student thinking.

Fernandez and Feliu (2020) stated that not only adults but also children can develop critical thinking skills, and suggest the development of critical thought early on. We wish to explore this deeper, especially in elementary school students. The ability of critical thinking contributes greatly to cognitive development in early childhood. Learning does not only rely on the ability to capture information but also the ability to identify information to avoid information errors.

For example, when children start school, they will absorb a lot of information from their environment. If the children have no support in the ability to analyze information, they can be easily misled (Brosseau-Liard, 2017). Children who have critical thinking abilities can absorb knowledge and exhibit their performance, become effective communicators, dynamic thinkers, good problem solvers, and become experts in their careers (Zivk Ovil, 2016). In early childhood, low concentration is prominent, requiring appropriate adjustments to the strategy and learning media that appeal to children (Cibralic et al., 2020).

Critical thinking capabilities can be encouraged by playing activities and the interaction of children with their environment (Wang et al., 2021). According to Leicester and Taylor (2010), several aspects can be developed in accordance with the components of critical thinking. Some aspects that need to be considered in developing critical thinking abilities in children include; (a) Asking Questions. Asking questions is a habit that must continue to be promoted and developed in the learning process. This is because identifying and conducting a discussion, and giving questions from the results of the discussion is part of critical thinking; (b) Point of view. Children must be trained to be able to view perspectives and self-opinions. For the development of perspective aspects, children must learn to understand and assess a problem and can also defend their opinions, so that children can discover evidences to support other different opinions; (c) Being rational. Familiarizing children can explain the reasons for their perspective and train children to accept differences in the perspective of others. In an effort to support their opinions, more than reasoning is needed. Logical and real evidence is required to help children distinguish between strong and weak opinions, and helping them become more open to accepting opinions; (d) Finding out. The desire to find something novel is also characteristic of children who can think critically. A highly curious child will often ask a lot of questions. Things they are curious about can range from simple to complicated. This curiosity that can be identified is a characteristic of critical thinking; and (e) Analysis. Analyzing an object or problem incorporate several parts, such as conceptual analysis, meta-analysis, categorization, and comparison. These three parts must be learned and understood by children to involve recognition and categorization.

Development of important aspects to train students' critical thinking ability requires appropriate learning methods. In a study conducted by Collins (2016), it was found that discussions involving language with high cognitive levels were proven to stimulate and affect the child's critical thinking ability. This activity includes reading a story book followed by discussion.

Initially, the researcher (Collins, 2016) created the experimental groups and control groups. Both groups consist of children with an age range of 4 to 5 years. The experimental group will be given a discussion time with two different language techniques, the low cognitive level language and high cognitive level language. Meanwhile, the control group was not given the opportunity to discuss. After the activity ended, all children were tested on their understanding of the story. From the test it was found that children going through discussion with high cognitive level language obtained the best test scores. This indicates that there is a link between children's critical thinking skills and discussions that require high cognitive abilities.

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One way to improve the ability to think is to use categorical syllogism. Categorical Syllogism is a logical argument consisting of 2 logical propositions called the premise and logical conclusions obtained from the premise (Senturk, 2019). Wasielewski et al., (2021) provides a more detailed explanation of Critical Syllogism. He explained that critical syllogism is a logical argument consisting of two premises (assumed to be true) and a conclusion that will be evaluated as a valid conclusion (if in accordance with the two premises) or invalid (if not in accordance with the two premises).

One of the syllogism category tests is the Cornell Class Reasoning Test (CCRT), which was first developed by Robert Ennis from the University of Illinois in Urbana-Champaign in 1964. Cornell Class Reasoning Test aims to measure the ability to think critically in students. We adapted the Cornell Class Reasoning Test to be simpler, and changed a few words in the questions to be easily understood by children. This study aims to determine the level of critical thinking skills of 4th grade students at SDN X and SDSK Y based on the Cornell Class Reasoning Test. Analysis of critical thinking skills will serve as information that can be used by teachers and schools to design appropriate learning activities and that are in accordance with the needs of children. The designed learning activities will then improve students' critical thinking skills.

Balwant (2017) claims that engagement is a form of active emotional, behavior, and cognitive involvement by students in academic activities. The study shows that the engagement of students can directly predict learning outcomes, skills in critical thinking, achievements in the academic field and learning satisfaction. Engagement in students has become one of the indicators of higher education quality (Wang, 2021).

Structural constructs in engagement have several components, namely: (a) a statement of motivating desires; (b) there is a scheme of social interaction; (c) characteristics of situations that can generate desires; and (d) exhibited behavior patterns (Verner, 2022). Therefore, to find out the level of engagement of a student on something, observations are needed to the components above. Engagement intensity can also fluctuate depending on the development of student learning. Therefore, it is important for students to be continuously given adaptive support during the learning process. The process of assessing the development of student learning over time allows us to understand the progress and results in the development of students' thinking skills (Ifenthaler and Seel, 2005).

2. RESEARCH METHOD

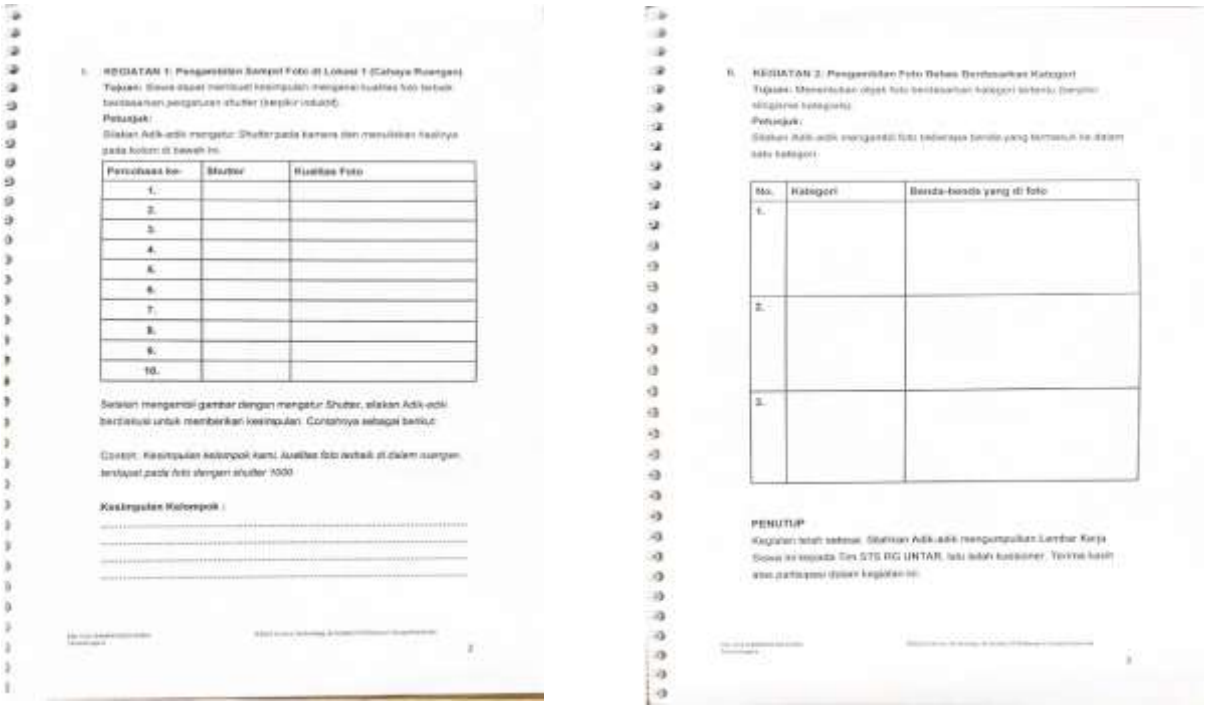
This study was conducted in March 2023. The subject of this study were 4th grade elementary school children totaling 58 students, consisting of 24 elementary students in Salatiga, and 34 students from elementary school in Yogyakarta. In elementary school in Salatiga, 6 groups were formed. Each of these groups consists of 4 students. Meanwhile, in elementary school in Yogyakarta 6 groups were formed. Of the 6 groups, 4 groups consist of 6 students, and 2 groups consist of 5 students.

This study uses the Quasi-Experimental data collection technique. Quasi-Experimental Design is a type of research design that does not meet all the requirements of an experimental study, for example, the participants are not randomly selected. The experiment was carried out by providing treatment in the form of training, and ended by filling out questionnaire pertaining to their training, and analyzing changes that occurred before and after treatment was given.

The observation was conducted by giving student worksheets to each group in which there are 2 sections that must be filled. The first part is a table that contains the shutter number used and the photo quality of the shutter. Previously, the research team provided a camera that would be used by each group on their respective tables along with the objects to be photographed. After providing all the equipment needed to conduct research, the research team explained the procedures for operating cameras and lighting.

Immediately after, the students practiced photographing the objects that the researchers have provided with different shutter choices. Students are asked to fill in the shutter setting they use and write down the quality of the photos taken with said shutter setting. They were given as many as 10 attempts for taking photos. Students are also asked to draw conclusions and determine which shutter setting produces the best photo quality among the 10 attempts. The aim is to find out how many attempts the students require to understand and take good quality photos. Furthermore, students will fill in the second part of the worksheet where students must group objects around them. Part two of the worksheet is a table divided into two columns where the first column is the category of the object and the second column is the name of the objects included in the category. Students are asked to fill in at least 5 objects in each category.

Figure 1
Worksheet



To measure the ability to think critically, especially categorical syllogism in students, researchers use the Cornell Class-Reasoning Test X measuring device to find out the level of reasoning for students. The measuring instrument contains 72 questions and 6 examples in which the questions consist of 2 logical propositions (premises) and logical conclusions from the premise. To answer the question, students will choose the answer "yes", "maybe", or "no" in accordance with the answers they specify.

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The answer "yes" indicates that the statement is true, answering "no" indicates that the statement is wrong, and answering "maybe" indicates that the statement is strange and that they are struggling to determine which answer is appropriate. Due to time constraints in research, the research team only uses 10 questions that were later answered by these students. The following are examples of questions that we have adapted from the Cornell Class Reasoning Test;

Table 1
Examples of Translation of the Cornell Class-Reasoning Test to Indonesian Language

No	English	Indonesia
1.	Suppose you know that: • All the cars in the garage are Mr. Smith's. • All Mr. Smith's cars are Fords. Then would this be true? • All of the cars in the garage are Fords.	Misalkan Anda tahu bahwa: • Semua mobil di garasi adalah milik Pak Budi. • Semua mobil Pak Budi adalah Avanza. Apakah pernyataan di bawah ini benar? • Semua mobil di garasi adalah Avanza.

3. RESULT AND DISCUSSION

In an effort to find out the level of engagement of SDN X students and SDSK Y, a comparison was made in the camera shutter experiment to find out the activeness and responsiveness of students.

Table 2
Camera Shutter Experiment Results SDN X

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
25	10	125	100	100	125
60	20	80	160	60	100
30	40	60	50	50	80
40	80	160	80	30	25
80	125	50	20	20	200
125	160	30	**15**	40	8
160	200	40	10	200	30
50	250	1200	13	25	2.5
250	320	**25**	8	15	**3**
15	**1**	2000	5	**5**	1.3

Table 3
Camera Shutter Experiment Results SDSK Y

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
40	200	125	60	10	5
60	80	200	80	30	6
30	**100**	100	40	40	10
80	160	20	10	25	60
500	125	320	5	20	2.5
125	60	15	100	60	5
320	250	2000	3	50	2
20	30	1	2.5	15	**1.3**
15	1600	30	2	5	1.5
25	1	**80**	**1**	**8**	1.6

The table above shows that on average, the best photo was taken in the 10th experiment. The shutter number in bold indicated the shutter number used to get the best photo quality. The number of experiments conducted by students shows high activeness and engagement by students. They

attempted to find the best photos by trying various shutter settings. In addition, the observations made by the mentor claimed that 84% or around 49 of 58 students were actively involved in camera training. They showed interest in learning how to operate the camera and become an active listener during mentors' speech.

The measuring instrument used in the Critical Thinking Categorical Syllogism research is the Cornell Class Reasoning Test. Students are asked to fill in 10 questions regarding 2 logical (premise) propositions and logical conclusions from the premise. Based on the results of the questionnaire answers, it was found that the average student could answer 3 out of 10 questions. The least they could answer is 0 questions and the most they could answer was 6 out of 10 questions. When given the questionnaire, many students asked the mentors how to fill it in. Based on the results of observations, students seem to require more guidance to be able to understand the questions given. The mentors claim that this is because the questions they made seem too complicated to be assigned to the subjects, who are elementary school students. The students also asked about the meaning of some of the words in the questionnaire. Therefore, the measuring instrument still needs improvement.

The mentor interviewed some subjects from SDN X and SDSK Y. Students interviewed are representatives of each group who completed their tasks first within their groups. Interviews conducted with students are about impressions on camera operating training. The mentor gave 5 questions to the students. All students interviewed managed answer all the questions well. Based on observations from the mentors, all students answered interview questions actively and enthusiastically.

The students are also disciplined and responsible. They work on problems diligently and seriously, wasting no time. The children dared to ask the mentor when they find confusing questions. In addition to asking questions about the questionnaire, children also ask questions about the camera, such as how to take good photos using a camera. They listened when the mentor explains. This is proof that there is an increase in engagement towards the activities. The conclusion of the answers given by students at Salatiga Elementary School and Yogyakarta Elementary School is that all students are happy to follow the entire series of activities. In addition, all students claim that they wish to participate again when given training as has been given by the mentor. They claim the reason they wish to participate again is their interest in learning more about cameras.

4. CONCLUSIONS AND RECOMMENDATIONS

This study discussed categorical syllogism training in elementary school children at SDN X and SDSK Y. The purpose of this study is to find learning methods that can develop critical thinking skills, and develop measuring instruments for this ability. During the experiment to find the appropriate shutter to produce the best photo quality, students showed activeness and characteristics of engagement in operating the camera and finding the shutter that produces the best photo quality.

Based on the results obtained from the Cornell Class Reasoning Test and worksheet data filled by 4 graders of SDN X and SDSK Y, students have not been able to answer the questions as expected. This might happen because students are not accustomed to answering categorical syllogism questions. In addition, it is possible that the focus of learning and learning systems that have been applied fail to develop students' critical thinking skills. Another possibility is that the measuring instrument developed still requires further improvement.

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Based on the above research, it is advisable to teachers and schools to pay attention to the development of students' critical thinking skills. Teachers and schools can also be advised to provide training so that children's critical thinking skills can continue to develop. In addition, the ability to think critically, especially in early childhood, is an indicator of higher education and is a benchmark for children's intelligence.

The results obtained from interviews with group representatives at SDN X and SDSK Y represent how each student feels about the activities and how their behavior is in school. In the future, the research team can provide relevant questions related to the camera, such as reconfirming their understanding of the camera after the activity. What the students have learned from the worksheet may be included, and how to work on the final questionnaire.

The research team also suggested providing ice-breaking sessions in the form of games that can increase the focus and engagement of students in the continuity of the activity program. Not only that, ice-breaking can help build rapport between mentors and children. Rapport is a close and harmonious relationship. This relationship consists of the feelings and ideas of a group of people.

Good rapport helps us establish communication with each other. Examples of games that can increase focus and engagement are (a) paying attention to an object that is thrown upwards and then caught again accompanied by a fast and hard clap and; (b) Snakes and worms: When "snake" is mentioned, students must extend both arms and when "worm" is mentioned, students must retract both arms.

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