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CRITICAL AND CREATIVE THINKING SKILLS FOR MATH STORY PROBLEMS INSTRUCTION AT ELEMENTARY SCHOOLS

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Abstract

Following the 2013 curriculum, the mathematics learning process requires critical and creative skills to help students solve math problems. Students who maximize critical thinking can conclude the information obtained, know how to use the information in math story problems, and find sources of supporting communication in solving a problem. In addition, the students must have creative thinking skills that find new ideas from math story problems. This study discusses the importance of critical and creative thinking skills in elementary school students to solve math story problems. This study uses a literature review because this article was based on other studies' particular topics. Researchers use concept analysis with a generic analysis design as an integrative review to identify the essential meaning. Critical thinking ability is an active process that continuously and thoroughly contains one's thoughts about something in-depth to decide what to believe or do. At the same time, creative thinking ability is to bring up or bring up a new idea based on previous experience. New ideas emerge from old ideas combined in new ways. The learning model that supports students in solving story problems is Problem Solving.

Keywords: Thinking skills, creative, critical, story questions, elementary school students

INTRODUCTION

Based on TIMSS 2015 results data, Indonesian education ranks lowest in international mathematics scores (TIMSS, 2019). In 2015, Indonesian students Mathematics skills were 386 out of an average of 490. This score indicates that Indonesia is still very far behind. Many students have difficulty learning mathematics (Utari et al., 2019; Yeni, 2015). The causes of errors in solving mathematical problems, in general, can be divided into two factors, namely internal and external factors. Elements from internal factors are intelligence, talent, attitude, motivation, and interest. Meanwhile, external

factors are environmental (natural and social) and instrumental (curriculum, programs, teachers, and facilities).

Following the 2013 curriculum, teachers are required not just to provide information on a theory or concept to students in the mathematics learning process. Innovation is needed to develop material related to problem-solving that exists in everyday life (Hermianto Sofyan et al., 2017). In its implementation, skills are a must, and it can help students solve a problem on math problems. One of the skills that students must have is critical and creative thinking skills (Conklin, 2012). Students who maximize critical thinking can conclude the information obtained, know how to use the information in math story problems, and find sources of supporting communication in solving a problem. In addition, students must have the ability to find new ideas or ideas from mathematical story problems or so-called creative thinking skills. By thinking creatively, students get demands in understanding, mastering, and solving the problems they face.

Teachers can use one of the learning methods in the classroom to encourage students to be more interested and enthusiastic in solving mathematical practice questions is problem-solving (Hermianto Sofyan et al., 2017). Teachers always provide stimuli to students in sudden quizzes and everything that adds to students' interest in finding a way out or answering the truth.

Problem-solving is not a mere teaching method but a method of thinking because in problem-solving, one can use other methods, starting from looking for data to concluding. With problem solving-based learning, students will be accustomed to working on math story problems they face (Zweng, 1979). Students will experience critical and creative thinking processes. Think critically in identifying a problem they face. Think creatively to find alternative solutions to solve a problem. Students will interact with the difficulties they face by thinking best solution they have. The students' interaction with this problem also helps find a specific mathematical concept

in the problem-solving. The effect size test results show that the problemsolving learning model significantly impacts students' critical thinking skills (Maharani et al., 2021). This result is also supported by research conducted by Anggy et al., which shows a significant effect of problem-solving methods on students' mathematical creative thinking skills with a classical absorption rate of 87.10% (Prawiyogi et al., 2020). Another study was also conducted by Chiam Ching Leen, which stated that critical and creative thinking skills could be improved through teacher preparation and professional development programs, changing the form of assessment, incorporating technology in teaching and learning (Leen et al., 2014). Anastasia also conducted research showing that problem-based learning models can improve critical thinking skills and learning outcomes in solving story problems in mathematics subjects in grade 4 SD Negeri Suruh 01 (Asriningtyas et al., 2018). From various previous studies, there has been no research that discusses critical and creative thinking skills, specifically in solving problems in mathematics. Therefore, the researcher examines in-depth critical thinking skills, creative thinking skills, and mathematical problem-solving.

RESEARCH METHOD

This study uses literature review, a series of studies relating to library data collection methods, or research through various library information (books, encyclopedias, scientific journals, newspapers, magazines, and documents) (Sukmadinata, 2005). The literature review examines or critically reviews knowledge, ideas, or findings contained in the body of academic-oriented literature and formulates theoretical and methodological contributions to specific topics (Marzali, 2016).

The researcher used literature review to produce an article on a particular topic based on studies conducted on books, journals, and scientific articles published and observing the subject being studied (Marzali, 2016).

Searching, selecting, weighing, and reading literature is the first thing a researcher does for what he wants to learn (Creswell & Clark, 2017).

The nature of this research is descriptive analysis; e.g., the data obtained regularly is processed, then given an understanding and explanation so that it can be understood well by the reader. This research's type of literature review is concept analysis with a generic analysis design to identify the essential meaning. This analysis isolates the elements that distinguish a concept from other words. The result of this genetic analysis is the clarity of an idea. The indicator is the availability of definitions and arguments that support these definitions (McMillan & Schumacher, 2010). The generic analytical design can be referred to as an integrative review. This method is implemented through five stages, e.g., (1) data collection; (2) Research questions; (3) hypothesis to be tested; (4) Data presentation and (5) Concluding (Brady & Asselin, 2016; Whittemore & Knafl, 2005). The data sources in this article are journals and books related to elementary school students' critical and creative thinking skills.

RESULTS AND DISCUSSION

Critical Thinking Skills

According to the Indonesian Dictionary, critical thinking consists of two related words. Thinking from the primary word "think" means reason, memory, wishful thinking. While necessary means not being quick to believe, it always finds errors or mistakes and is sharp in analysis (Indonesia, 2008). Critical thinking means a human mental activity on the response faced around it logically. John Dewey, who is seen as the 'father' of the modern critical thinking tradition, defines it as an active, persistent, and thorough consideration of a belief or form of knowledge that is taken for granted in terms of the reasons that support it and further conclusions is the tendency (Fisher, 2011; Sudarma, 2016). It means that the essence of critical thinking is an active process that continuously and thoroughly contains one's thoughts

content about something in-depth, which can lead to a question or obtain relevant information based on supporting reasons or beliefs. One of the most famous contributors to developing the tradition of critical thinking, Robert Ennis, defines it as reasonable and reflective thinking that focuses on deciding what to believe or do (Ennis, 1962).

Some critical thinking activities, according to Ennis, are: interacting with other people, formulating problems, analyzing arguments, asking and answering questions, assessing the credibility of information sources, observing and evaluating reports on observations, identifying assumptions, making deductions, and evaluating hypotheses, assessing induction, identify and assess identification, evaluate, decide and implement something (Ennis, 2015). Students who carry out critical thinking activities have carried out a mental exercise produced clearly and rationally. They can filter information received without asking others. Because they can analyze and evaluate a fact/information to determine what action or solution should be taken. The characteristics of students who can think critically are described by Lau as follows:(Lau, 2011)

- a. Able to understand logical relationships between ideas.
- b. Able to formulate ideas concisely and precisely.
- c. Able to identify, construct, and evaluate arguments.
- d. Able to evaluate decisions.
- e. Able to evaluate evidence and hypotheses.
- f. Able to detect inconsistencies and common errors in reasoning.
- g. Able to analyze problems systematically.
- h. Able to identify the relevance and importance of ideas.
- i. Being able to assess a person's beliefs and values.
- j. Able to evaluate one's thinking ability.

In the process of critical thinking, some stages are passed. Robert Ennis identifies essential thinking skills into FRISCO's five major activities (Focus, Reasons, Inference, Situation, Clarity, and Overview) (Ennis, 1962). Facione

has other stages in critical thinking, namely interpreting, analyzing, evaluating, concluding, and explaining what is in his mind that is obtained to make decisions. (Facione, 2011). According to Perkins & Murphy, critical thinking in mathematics is divided into four stages: clarification, assessment, inference, strategy/tactics. (Kennedy et al., 2004). It can be seen that the critical thinking process has various types that several figures have proposed. This stage identifies that the critical thinking process is passed from the lowest setting to the highest stage. Each step shows the ability of students' critical thinking processes that are different. In table 1, the researcher concludes critical thinking's similarities and differences at each stage conveyed by each figure.

Table 1 Similarities and Differences in Critical Thinking Stages

Channel of militar		Theory of the characters	_
Stages of critical thinking	Robert Ennis	Facione	Purkins & Murphy
Stages 1	Focus	Analytical interpretation	Clarification
Stages 2	Reasons	Inference	Assessment
Stages 3	Inference	Evaluation	Conclusion
Stages 4	Situations	Explanation	Strategy/tactics
Stages 5	Clarity	Self-control	
Stages 6	Overview		

In this study, the researcher uses the critical thinking stage developed by Robert H. Ennis, known as FRISCO. At this stage, the process in making the decision is faced with the problems awareness and careful consideration to the predetermined solutions (Ennis, 2015). The following is an indicator of Frisco's critical thinking.

a. Focus

Focus is to focus attention, and it is the first thing to do when facing something. Using focus, one will know the answers to the question that arises oneself. The stages of focus will be known if someone knows a conclusion that looks easy and trivial.

b. Reason

Reason includes the evidence base used to corroborate an opinion or argument. Explanations are needed when formulating ideas, whether they are pro or con. Sometimes illustrations are used to strengthen the evidence that has been found in solving problems both when conducting experiments or conclusions.

c. Inference

Conclusions are obtained from the evidence and reasons found. Conclusions are obtained from a step to find explanations. A conclusion was reached by staying focused.

d. Situation

A situation is a state, thing, location, place, position. Conditions include people involved in a cause, history, loyalty, knowledge, emotions, prejudices, talents, and interests.

e. Clarity

Clarity can judge conclusions from reasons. This clarity contains a coherent and understandable quality.

f. Overview

An overview is an overview when asked to assess whether it has been found, decided, considered, studied, and concluded. In short, the summary shows whether the series of steps that have been carried out makes sense. Researchers have formulated the following indicators in table 2:

Table 2. Indicators of Critical Thinking Skills

	Critical	Indicator	Category			
Step	Thinking Stage		Α	В	С	
1	Focus	The suitability of identifying information (question).	information with	Write a report with different sentences and similar purposes.	Write down the data with other rulings and different meanings.	
2	Reason	Expressing arguments of problems and	Write down problems and solutions in total.	Write incomplete problems and	Write a complete problem and	

		solutions.		complete solutions.	incomplete solution.
3	Inference	Summarize the relationship between the problem and the solution.	Write the material wholly and correctly.	Writing the material wholly and correctly.	The writing material is not correct.
4	Situation	Solve problems based on written solutions.	Complete with a coherent and thorough.	Complete with less coherent and thorough.	Complete with a coherent and less thorough.
5	Clarity	Explain the solution.	Write solutions in understandable, meaningful, and interconnected sentences.	Write the solution in less understandable, meaningful, and interconnected sentences.	Write the solution in understandable sentences, less meaningful, and interconnected
6	Overview	Provide judgmental arguments.	Write a complete and logical argument.	Write a complete and illogical argument.	Writing arguments incompletely and logically.

Creative Thinking Skills

Creative in the Indonesian Dictionary means having creativity and creating (Indonesia, 2008). Creative thinking is a mental activity in bringing up or bringing up a new idea based on incorporation or previous experiences carried out. New ideas emerge from old ideas combined in new ways (Lau, 2011). The ability to process experiences using specific methods to produce something that has added value and can be realized. It is the difference between imagination and creativity. Creative thinking is not something that is given, carried from birth. Creative thinking is an artificial process by finding methods until the most appropriate way to think is obtained (Majaya, 2013). Activities will bring up various alternative solutions to solve a problem using creative thinking (Anwar et al., 2021). The results of creative thinking will bring up creativity which is called the creative thinking product.

Humans are creatures who have creative abilities with the aim of helping them do more than rationally from the data and knowledge they have (Sudarma, 2016). It shows that every human being has creative thinking skills, either active or passive. This ability is influenced by the environment that interacts with humans. The more challenging the environmental

conditions or the conditions that are not qualified, that is where creativity will emerge. Several situations make people think creatively: 1) We need to get something new or varied to be better. 2) Get the urge to communicate values and ideas. 3) Have a desire to solve problems (Weisberg, 1993). In other words, different environments can affect human creative thinking. It can also be the basis for every human's thinking level. There are high, medium, and low-level creative thinking people.

Human creative thinking activities will produce a product or result called creativity. John Adair argues that creativity is the mind and soul's ability to manifest what seems to be non-existent or considered useless into things that are realized, helpful, and even necessary (Adair, 2007). In other words, creativity is a product obtained from a process, either from an idea or an object that has a new arrangement.

In carrying out creative thinking activities, there are stages of creating creativity. According to Krulik and Rudnik, the creative thinking process consists of: (Krulik & Rudnick, 1995):

- a. Building an idea regarding generating ideas related to a given problem.
- b. Synthesize ideas, weave or combine thoughts that are owned either from learning in the classroom or from experiences in everyday life.
- c. Planning to implement the ideas by choosing a specific idea used in solving the problem.
- d. Applying ideas to produce something new means using or implementing ideas that have been planned to solve problems.

The creative thinking process goes through various stages, starting from low to high levels. One of the figures who proposes the steps in creative thinking is Silver, and he has three critical, innovative assessment components: fluency, flexibility, and elaboration (Hendriana & Soemarmo, 2014). From the three components of the creative thinking assessment, the

researcher formulates the indicators used in the study. The following discusses the three evaluations of creative thinking:

a. Smoothness

Fluency or eloquentness is viewed to see the number of ideas and the use of previously possessed knowledge to respond to a problem. Fluency refers to the number of issues or questions asked variously and correctly in analyzing students' mathematical creativity.

b. flexibility

Ability to adapt to changing ideas approaches to problems, and various solutions are generated to deal with problems. In this case, changing the knowledge possessed is then decided to respond to the problem response. It can categorize different issues with different results.

c. elaboration

Originality or novelty of ideas generated in response to problems. How rare is the response from the others, solve or answer the problem with several different answers with correct values.

Table 3. Indicators of Creative Thinking Skills

	Creative		Category		
Step	Thinking Stage	Indicator	Α	В	С
1	Fluency	Knowing and managing knowledge to find solutions.	Writing with complete and varied problems and solutions.	Writing the problems and solutions.	Writing one problem and one solution correctly.
2	Flexibility	Solve problems based on knowledge	Knowledge Interpretation from the question and everyday life reasonably and logically.	Knowledge interpretation from material and everyday life is less valid or less logical.	The correct knowledge interpretation from the question of everyday life.
3	Elaboration	Problem- solving process	Express other ideas/arguments /solutions in solving problems correctly and logically.	Express one of the other ideas/argument s/solutions in solving problems	Express one of the ideas/arguments/ solutions in general in solving problems correctly and

Step	Creative Thinking Stage	Indicator		Category			
			A	В	С		
				correctly and logically.	logically.		

Solving Math Story Problems With Problem Solving

Math story problems are often found in students both when learning mathematics and in math exams. Math story questions are widely used to determine how far the students understand the competency goals achieved (Corte, 2000). On the other hand, students are honed to propose solutions to problems obtained from story questions. The following is an explanation of the various forms of math story problems at the elementary school level:

a. Addition story problem

The summation story problem is a question in the form of a story by presenting a condition using several keywords such as merged, given again, asked again, picked again, bought again. (Raharjo et al., 2009).

b. Subtraction story problem

Subtraction story problems are story questions found in daily activities, including problems in mathematical sentences and subtraction. Some of the keywords used in the sentences of the subtraction story problems are asked, borrowed, given to, sold, used.

c. Multiplication and division story problems

Multiplication and division story problems are presented by telling a problem. Some questions will show issues that exist in everyday life.

d. Mixed-story

Mixed-story questions present questions in which there are problems with Problem-solving addition, multiplication, division, and multiplication. Both consist only of addition and subtraction, as well as multiplication by division. Sometimes a combination of these four elements.

e. Problem Stories Speed, Distance, and time.

Story questions related to speed, distance, and time have a close relationship with everyday situations.

Completing a story problem requires efficient steps so that students understand the concept as a whole. According to Royani, the following steps can be taken in solving story problems:(Royani, 2008)

- a. Identify what is known and asked in the story problem.
- b. Change math story problems into math sentences.
- c. Perform calculations.

The learning model that supports students in solving story problems is Problem Solving. The situation means problem, and solving means solution. Problem-solving is a way in which an individual uses previously acquired knowledge, skills, and understanding to meet the demands of strangers. The process begins with an initial confrontation, ends when the answers have been obtained and considered on the initial conditions. Students must synthesize what they have learned and apply it to new and different situations. (Krulik & Rudnick, 1995).

Problem-solving is a process. So, teachers must develop a set of heuristics to follow and then be sure to use them. What is important is that students study the heuristic model, develop or organize a series of "questions" to ask themselves and that students constantly refer to the questions when faced with problem situations.

The aspects teachers can do to help students develop heuristic processes and help students become good at problem-solving. Here are some activities that teachers can use in the classroom.

- 1) Creating an atmosphere of success
- 2) Encourage students to math story problems
- 3) Teach students how to read or understand problems.
- 4) Involve students in problems.
- 5) Ask students to create or post their problems.

- 6) Ask students to the group.
- 7) Encourage the form of pictures.
- 8) Provide alternative suggestions when approaching problem-solving.
- 9) Give relative and constructive questions.
- 10) Emphasize creativity and imagination.
- 11) Emphasize estimation.
- 12) Utilize existing digital programming.
- 13) Ask students to complete the stages of the solving process independently.
 - 14) Using game strategies in the classroom.
 - 15) Include issues that require more than one step.
 - 16) Do not teach new material at the same time.

Based on *Permendikbud* Number 6 of 2014, learning mathematics aims to make students understand mathematical concepts, solve problems, use mathematical reasoning, communicate problems systematically, and have attitudes and behaviors that follow values in mathematics. The National Council of Mathematics Teachers formulates five basic mathematical abilities. It is the standard of mathematics learning objectives, namely, Problemsolving (problem-solving), reasoning and proof (reasoning and proof), communication (communication), connection (connection), and representation (representation).

CONCLUSION

The essence of critical thinking skills is an active process that continuously and thoroughly contains one's thoughts contents about something in-depth to decide something that must be believed or done. This study uses the FRISCO critical thinking stages (Focus, Reason, Inference, Situation, Clarity, Overview. At the same time, creative thinking skills generate or bring up a new idea based on previous experience. New ideas emerge from old ideas combined with new ways. The stages of creative

thinking are fluency, Flexibility, and Elaboration. The learning model that supports students in solving story problems is Problem Solving. Problem-solving is a process. So, the teacher must develop a set of heuristics to follow and then use it. The teacher can assist students in developing the heuristic process and help students become good problem solvers.

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