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The Improvement of Students' Mathematical Critical Thinking Skills and Learning Motivation Through Contextual Teaching and Learning

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Abstract

This research aims to investigate the improvement of students' critical thinking skills and learning motivation using a problem-solving approach through Contextual Teaching and Learning (CTL) on the topic of statistics with the assistance of GeoGebra. This study employs a pre-experimental research design with a one-group pretest-posttest approach. The sample consists of one eighth-grade class in a public junior high school in Yogyakarta. Data collection techniques include pretests and posttests to measure students' critical thinking skills and a questionnaire to assess students' learning motivation. The paired sample t-test is utilized for data analysis. The results reveal improved critical thinking skills, with an average pretest score of 49.33 and a posttest score of 85.00. Students' learning motivation also increased, with an average pretest score of 73.60 and a posttest score of 88.87. The t-test result shows a significance value of 0.000 < 0.05, indicating the rejection of the null hypothesis. This implies that a problem-solving approach through contextual teaching and learning in statistics has a significant influence on students' critical thinking skills, resulting in an enhancement of students' critical thinking skills.

Keywords: CTL, Learning Motivation, Mathematical critical thinking skills, Mathematics learning

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INTRODUCTION

Mathematics has a significant contribution to the advancement of science and technology (Kusmaryono, 2014). Mathematics is a thinking tool that helps students understand and solve problems they face in daily life using mathematical concepts. In addition, mathematics learning can be a meaningful learning process where students can acquire new knowledge beneficial for themselves and others after completing mathematics learning, thus requiring vital mastery of mathematics. Therefore, this subject is given to all students starting from elementary school, as stated in Permendikbudristek No. 7 of 2022 about the Standard Process of Basic and Secondary Education (Kemendikbud, 2022).

The Pancasila student profile is a translation of the national education goals in the independent curriculum. In the Indonesian Ministry of Education and Culture Regulation Number 22 of 2020, the established Pancasila student profile consists of 6 elements: (1) faith, piety towards God Almighty, and noble character, (2) global diversity, (3) cooperation, (4) creativity, (5) critical thinking, (6) independence (Kemendikbud, 2020). In the 21st century, students need thinking skills that can assist them in making decisions and acquiring new knowledge (Fuad et al., 2017). 21st-century skills are generally understood to encompass various competencies, including critical thinking, problem-

solving, creativity, metacognition, communication, literacy, and responsibility (Kim et al., 2019).

One of the skills that students must have is critical thinking. Critical thinking is the ability to process, evaluate, and use the information obtained to find the right solution (Samura et al., 2020). Students who have critical thinking skills tend to be able to construct their knowledge, which is helpful in life. Thus, it can increase students' motivation to solve daily problems (Amin et al., 2020). Therefore, critical thinking skills need to be made a habit by being trained in school learning so that it can become a provision for students to face the future.

In addition to the cognitive domain, students' learning motivation when studying mathematics is also needed. Mathematics learning will be more meaningful and exciting, requiring encouragement from within the students themselves and encouragement from outside the students. The encouragement referred to is motivation. Students' learning motivation significantly determines their success (Djamarah, 2011). A student achieves good results, one of which is because the student has high learning motivation. Students will be more enthusiastic and diligent in learning activities by having high learning motivation.

Students' critical thinking skills and motivation are still not optimal. This is evident from the research conducted by Novita et al. (2022), which shows that students' average mathematical critical thinking ability is 44.06%, categorized as moderate. This is reinforced by data from each indicator of mathematical critical thinking ability, namely 36.69% (low category) for the identification indicator, 36.18% (low category) for the connection indicator, 46.05% (moderate category) for the analysis indicator, and 44.98% (moderate category) for the problem-solving indicator. This aligns with the research results of Putri & Warmi, 2022 Jumaisyaroh, Napitupulu, and Hasratuddin, 2015, which state that students' critical thinking skills are still low. The low level of critical thinking skills is because students only receive one-way information, namely only from the teacher, so students' ideas do not emerge. As a result, students' critical thinking skills do not improve (Suwanjal, 2016). In addition, remote learning during the COVID-19 pandemic has had an impact on students' learning motivation becoming low, which can be seen in students who are bored with learning only by doing the tasks given by the teacher, without any interaction with other students (Dharma et al., 2021).

The role of the teacher in learning is vital in creating a pleasant environment that can influence critical thinking skills and arouse motivation in student learning activities. Considering the importance of critical thinking skills and motivation in mathematics learning, an appropriate learning model is needed to create a pleasant learning environment for students. The Contextual Teaching and Learning (CTL) learning model is one of the appropriate learning models to be applied.

Contextual Teaching and Learning (CTL) is a learning method that actively involves students in discovering the concepts being studied by connecting the knowledge possessed by students with material in daily life (Selvianiresa & Prabawanto, 2017). The CTL learning model emphasizes student participation in discovering the studied concepts and connecting them with real life, thus encouraging them to apply them daily (Nurnadia et al., 2021).

The Contextual Teaching and Learning (CTL) model has seven components: constructivism, inquiry, questioning, learning community, modeling, reflection, and authentic assessment (Andarini et al., 2013). These seven learning components in CTL can help students develop their intellectual potential by directly teaching steps that can be used in critical and creative thinking, providing thinking skills at a higher level in the real world, and stimulating students to actively learn, be confident, and train students to communicate well.

Based on the problem background and the study that has been previously presented, the Contextual Teaching and Learning (CTL) model is an important variable suspected of influencing students' critical thinking skills and learning motivation. Therefore, this research aims to determine the effect of using the CTL learning model on these skills and motivation.

METHODS

This research is a quantitative descriptive study. The type of research used is pre-experimental research. The research design used is a one-group pretest-posttest. This research only uses an experimental class without a control class. In this study, there is one experimental class, where the experimental class is given a problem-solving approach treatment with the contextual teaching and learning model using discussion and question-and-answer methods.

The population in this study is all eighth-grade classes at Yogyakarta Public Middle School in the eighth semester of the 2022/2023 academic year. One class was randomly selected as the experimental group. In the experimental group, contextual teaching and learning will be applied. This research was conducted over six meetings with the details as follows: a pretest will be conducted in the first meeting, the researcher will conduct the learning process from the second to the fifth meeting, and in the last meeting, the researcher will conduct a posttest.

The data collection techniques are tests and questionnaires. The test used in this study aims to measure students' critical thinking skills; the test is in the form of multiple-choice questions. Indicators of students' critical thinking skills are presented in Table 1. The questionnaire in this study aims to determine students' motivation for learning mathematics. The questionnaire used contains 25 items that cover students' learning motivation. The results of the student learning motivation questionnaire use a Likert scale. The indicators of the student learning motivation questionnaire are presented in Table 2

Table 1. Indicators of students' critical thinking skills

Criteria for Critical Thinking Skills	Indicators
Clarification	Mentioning information to solve problems
Strategy	Determining strategies to solve problems
Assessment	Evaluating the truth of a statement
Inference	Drawing conclusions

Table 2. Indicators of student learning motivation

Dimension	Indicators
Perseverance in Learning	Completing tasks on time Participating in classroom learning
Persistence in Facing Difficulties	Being challenged to solve complex problems Not easily satisfied with the results achieved
Interest and Sharpness of Attention in Learning	Curiosity Interest in learning
Independence in Learning	The atmosphere of the learning place Creativity in delivering material
Performance in Learning	Recognition in learning Efforts to achieve dreams

The research process consists of several stages. The preparation stage is where the researcher determines the school, determines the research sample, and then prepares the completeness of learning used during the learning process activities. The learning completeness prepared is designing the Learning Implementation Plan (RPP), designing the Student Worksheet (LKS), and compiling the grid of test instruments in the form of multiple-choice questions and questionnaires. Experts first validate the instrument to obtain a quality instrument. The second stage is the implementation stage; at this stage, learning is carried out by the design and RPP that has been compiled. The third stage is processing data on critical thinking skills and student learning motivation.

Data processing is done to analyze the data obtained from the research results using descriptive and inferential statistical analysis. The data described in this study are the critical thinking skills scores and students' learning motivation scores. The collected data in the pretest and post-test scores are then compared. These two values are compared by proposing a hypothesis and then testing the hypothesis with a t-test. However, a normality test is carried out using the Kolmogorov-Smirnov test to determine whether the data obtained is usually distributed. Decision-making in this study uses a 5% significance level.

RESULTS & DISCUSSION

Results

The data obtained in this study consist of pretest and posttest scores of critical thinking skills and students' learning motivation scores. Table 3 describes the data on students' critical thinking skills, and Table 4 describes the data on students' learning motivation.

Based on the research results, improved critical thinking skills were obtained with an average pretest score of 49.33 and a posttest score of 85.00. Students' learning motivation also increased, with an average pretest score of 73.60 and a post-test score of 88.87.

Table 3. Description of Students' Critical Thinking Skills

No	Description	Pretest	Postest
1	Number of students	30	30
2	Average score	49,33	85,00
3	Standard deviation	15,96	10,42
4	Maximum score	70	100
5	Minimum score	20	70

Table 4. Description of student's learning motivation

No	Description	*Pretest*	Postest
1	Number of students	30	30
2	Average score	73,60	88,87
3	Standard deviation	14,18	11,39
4	Maximum score	101	111
5	Minimum score	51	69

Before conducting a hypothesis test, a prerequisite test is first carried out, and a normality test on the critical thinking skills scores and learning motivation scores is obtained. The normality of the data was tested using the Kolmogorov-Smirnov test statistic. The results of the Kolmogorov Smirnov test of critical thinking skills are in Table 5, and the results of the Kolmogorov Smirnov test of student learning motivation are in Table 6.

Table 5. The results of the Kolmogorov Smirnov test of critical thinking skills

Data	Sig.
Pretest	0.083
Posttest	0.011

Table 6. The results of the Kolmogorov Smirnov test of student learning motivation

Data	Sig.
Pretest	0.200
Posttest	0.200

Based on Table 5, the significance value of the pretest and posttest for students' critical thinking skills is > 0.05, so it can be concluded that the data is usually distributed. In Table 6, the significance value of the pretest and posttest for students' learning motivation is also > 0.05, so the data is usually distributed. Therefore, the data obtained is suitable for analysis with t-test statistics. The results of the hypothesis analysis through the t-test calculation can be seen in Table 7

Table 7. T-test results

	thing	Sig. (2-tailed)
Critical thinking skills	11.960	0.000
Learning motivation	10.903	0.000

Based on Table 7, it was found that the probability value of students' critical thinking skills and learning motivation is 0.000. This value is less than the significance level of 0.05, so H0 is rejected. In other words, students' critical thinking skills and learning motivation increased after implementing contextual teaching and learning. The data results of students' critical thinking skills in each critical thinking indicator are mentioning

information to solve problems, determining strategies to solve problems, evaluating the truth of a statement, and making decisions. The results show that each indicator of students' critical thinking skills increased after learning with a problem-solving approach through the CTL learning model. The following presents the percentage data per indicator of students' critical thinking skills in Table 8.

Table 8. Percentage results of critical thinking skills indicators

Indicators	Percentage	
	Pretest	Postest
Mentioning information to solve problems	83%	93%
Determining strategies to solve problems	70%	89,85%
Evaluating the truth of a statement	55,75%	72,52%
Drawing conclusions	57,67%	88,67%

Discussion

Contextual Teaching and Learning (CTL) is a learning method that strengthens, expands, and applies students' academic knowledge and skills in various situations, both outside and inside the school so that students can solve real-world problems. CTL has eight components: making meaningful connections, independent learning, doing meaningful work, collaborating, thinking critically and creatively, helping individuals to grow and develop, achieving high standards, and using authentic assessment (Johnson, 2010). This leads to the conclusion that CTL learning can enhance students' critical thinking skills. These findings are certainly reinforced by findings from previous research (for example, Suwanjal, 2016; Syahbana, 2012; Nur Shanti et al., 2018).

In addition to the cognitive domain, students' motivation to learn mathematics is also needed. During the COVID-19 pandemic, students' motivation to learn has decreased; students are bored with learning only by doing the problems given by the teacher, without interacting with other students (Suarsi & Wibawa, 2021). By using CTL learning, students' motivation to learn can be increased. These findings are reinforced by previous research results (for example, Septiani Kulsum et al., 2016; Putrianasari, D. & Wasitohadi, 2015).

The research results show that CTL learning influences statistical material on students' critical thinking skills and learning motivation. The results of students' critical thinking skills increased from an average of 49.33 to 85.00 after using CTL learning. From the results obtained, students' critical thinking skills increased after applying students' critical thinking skills. This is similar to the opinion of Suwanjal (2016), who stated that contextual learning is better at improving students' critical thinking skills than students who receive conventional learning. In terms of contextual learning, a teacher must be able to create a learning design closely related to daily life.

The average score of students' learning motivation after using CTL learning increased from 73.60 to 88.99. This means that students' learning motivation increased after using CTL learning. This is in line with the research results (Yuliana & Fajaruddin, 2017), which state that the increase in students' learning motivation by using contextual learning from pre-action students' learning motivation falls into the low category in cycle one becomes a high category and cycle 2 is a very high category, and all students have achieved success indicators.

Improving students' critical thinking skills and learning motivation by implementing CTL learning cannot be separated from the excellent cooperation between researchers and teachers. They note the obstacles faced during the learning process at each

meeting as a reflection material for researchers to implement the following learning. The teacher is a facilitator during the CTL model learning process. At the same time, students are motivated to be active in the learning process by looking for solutions to a given problem, having group discussions, and presenting learning outcomes. As a result, students gradually experience better development in critical thinking skills and learning motivation.

CONCLUSION

Based on the results and discussions, the conclusion is that implementing Contextual Teaching and Learning (CTL) in statistics subjects can improve students' critical thinking skills. CTL learning encourages students to be more active and responsive to mathematical problems. Furthermore, after implementing CTL in statistics, students' motivation to learn mathematics is categorized as moderate. Based on these findings, CTL learning is appropriate for enhancing students' 21st-century skills and learning motivation.

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