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Mathematical Problem-Solving Ability in STAD Learning Assisted by Question Cards in Terms of Student Learning Motivation

Mulyono[1*], Amira Sulkha Fatika[2]
[1]Mathematics Education Study Program, Faculty of Mathematics and Natural Science, Universitas Negeri Semarang, Indonesia.
[2] SMP Salafiyah Pekalongan, Indonesia.
*Corresponding Author. E-mail: mulyono.mat@mail.unnes.ac.id[1]
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Abstract

This research aims to determine the effectiveness of Student Teams Achievement Division (STAD) learning model assisted by question cards and description of mathematical problem solving ability in terms of students' learning motivation using STAD learning model assisted by question cards. The method used in this research is mixed method with sequential explanatory design. The subjects in this research were 6 people consisting of 2 students in each learning motivation category, namely high, moderate, and low. The results of this research showed that: (1) the mathematical problem-solving ability of grade VIII students after participating in STAD learning assisted by question cards on Probability material reaches learning completeness; (2) The average mathematical problem-solving ability of grade VIII students after participating in STAD learning assisted by question cards is higher than the average mathematical problem solving ability of grade VIII students who use conventional learning models; (3) The completeness of mathematical problem-solving ability of grade VIII students after participating in STAD learning assisted by question cards is more than the proportion of completeness of mathematical problem solving ability of grade VIII students using conventional learning models; (4) Subjects with high learning motivation fulfil all four indicators of mathematical problem-solving ability well. Subjects with moderate learning motivation fulfilled 3 indicators of mathematical problem-solving ability well.

Keywords: learning motivation, mathematics problem-solving ability, question cards, STAD

INTRODUCTION

Education is an important aspect of science and technology development. Education plays a role in developing the potential of human resources through teaching and learning activities in order to become innovative and creative citizens and realise quality human resources so they can compete with other citizens (Halean et al., 2021). Act of The Republic of Indonesia Number 20, year 2003 states that national education functions to develop abilities and form the character and civilisation of a dignified nation in order to educate the nation's life, aims to develop the potential of students to become human beings who are faithful and devoted to God Almighty, noble, healthy, scientific, capable, creative, independent, and become democratic and responsible citizens. Given the important role of mathematics in everyday life, mathematics learning should pay more attention and improve problem-solving skills in everyday life. (Antika, 2019; Fatimah, 2020; Fitriawan et al., 2023). Mathematics is very identical to solving mathematical problems and that the main purpose of education is for students to be able to solve problems in everyday life (Simanjuntak, 2021). The National Council of Teachers of Mathematics states that the goal of mathematics is for students to have five standards of mathematical ability, namely the process of problem-solving, reasoning and proof, connection, communication, and representation (NCTM, 2000).

But in reality, the results of the Programme for International Students Assessment (PISA) test in 2012, Indonesia ranked 64th out of 65 countries that took the test with an average score of 375. Indonesia's average score is quite far below the average score of the Organisation for Economic Cooperation and Development (OECD) which is 494 (OECD, 2015). The low PISA results are reinforced by the reality at school. Based on observations of interviews with teachers at SMP Salafiyah Pekalongan, information was obtained that students still find it difficult to solve mathematical problems in the form of narrative problems that require deeper understanding and problem-solving. Students are not accustomed to writing down the steps of completion and students' answers are still not by the problems given. This shows that students' mathematical problem-solving skills are still not optimal. The learning process provided by the teacher also still uses conventional methods that are only teacher-centred, making students less motivated to learn. Students only listen to the teacher's explanation and memorise formulas without being associated with everyday life as a result students become bored and sleepy during learning.

The importance of motivation in learners is also important in learning (Baier et al., 2019; Novianti et al., 2020). Learners who do not have motivation tend to be more bored in participating in learning activities, causing low mathematical problem-solving ability and also low academic achievement. Vice versa, (Järvenoja et al., 2020; Waritsman, 2020) mentioned that learners who are more motivated will obtain higher academic achievement as well. Therefore, learning motivation needs to be owned by every learner. When learners have high learning motivation, they will always try to solve the problems they face, actively participate in learning, and not give up easily in facing problems. Conversely, learners with low motivation will tend to give up easily and not try to solve a problem. This is in line with research conducted by (Rigusti & Pujiastuti, 2020) which shows the results that students with high learning motivation have high problem-solving ability. Meanwhile, students who have moderate learning motivation have moderate problem-solving ability and students with low learning motivation have low problem-solving ability.

One of the effective learning models to improve problem-solving ability is the Student Teams Achievement Division (STAD) type cooperative learning model (Gultom & Simorangkir, 2023; Saputra, 2022). The STAD-type cooperative learning model is a learning model where students learn in heterogeneous groups (achievement level, gender, culture, and ethnicity) consisting of 4-5 students (Wijaya & Arismunandar, 2018). The components of STAD according to Ariani & Agustini (2018) are (1) class presentation,

(2) learning in teams, (3) individual tests conducted after learning, (4) individual development scores, and (5) team rewards.

In addition to requiring a good model, educators need to use interesting learning media as well. Learning media is media that is used as a learning aid consisting of various types, including media based on living things, media based on print, media based on visual, media based on audio-visual, and media based on computer (Muhaimin & Juandi, 2023; Salam et al., 2022). One of the media that is often used in cooperative learning models is question cards (Arifin & Halim, 2021; Atiaturrahmaniah & Fajri, 2020; Sya'adah et al., 2023). Question cards are cards that contain questions that must be answered by students (Rohmah et al., 2019). Question cards have also been proven to be effective in mathematics learning (Fatra et al., 2023; Nada et al., 2020).

METHODS

The research method used in this research is mixed methods with a sequential explanatory research design. (Creswell, 2018) explains that explanatory sequential mixed methods are a method where researchers first conduct quantitative research, analyse the results, and then collate the results to explain them in more detail with qualitative research. The quantitative research design used is True Experimental Design in the form of Posttest Only Control Design where in this design the grouping is done randomly in both the experimental and control groups. According to (Sugiyono, 2013a, 2013b), the research design is described in Table 1.

Table 1. Posttest Only Control Design

Treatment	Test
X	P_1
Y	P_2

Description:

X : mathematucs learning with the Student Teams Achievement Division (STAD) and assisting with question cards

Y : conventional learning

P_1: test results of the mathematical problem-solving ability's experimental group

P_2: test results of the mathematical problem-solving ability's control group

The population in this research were students in SMP Salafiyah Pekalongan's grade VIII in the 2022/2023 academic year. Sampling was done by random sampling method. In this research, two classes were taken, namely class VIII D as the experimental group and class VIII E as the control group. The experimental group received learning with Student Teams Achievement Division (STAD) assisted by question cards, while the control group received a conventional learning model. The subjects in this research were six students of class VIII D, each in each category of 2 students representing high, moderate, and low learning motivation categories.

The variables of this research were mathematical problem-solving ability and students' learning motivation. The data collection methods used were tests, questionnaires, and interviews. The test method was used to collect data on mathematical problem-solving ability after learning mathematics with the STAD learning model assisted by question cards and conventional learning models. The questionnaire method was used to measure the learning motivation of experimental group students which was then used to classify students into high, moderate, and low motivation categories. The interview method in this research was conducted in an unstructured manner to obtain data on mathematical problem-solving ability in terms of students' learning motivation.

Quantitative data was obtained from the results of the problem-solving ability test. Qualitative data was obtained from interviews with six students based on the category of student learning motivation. The quantitative data analysis techniques used were (1) initial data analysis in the form of normality test, homogeneity test, and average similarity test of the final semester test of experimental and control class students, (2) final data analysis, namely normality test, homogeneity test, z-test hypothesis test to test classical completeness, mean difference test and proportion difference test.

The qualitative data analysis technique used was interviewed. Analysis of interview data in this research was carried out by reducing data, presenting data and drawing conclusions. Furthermore, qualitative data is tested for validity by conducting a credibility test, transferability test, dependability test, and confirmability test. The credibility test in this research was carried out by triangulating techniques, namely test and interview techniques (Natow, 2020; Raskind et al., 2019).

Indicators of mathematical problem-solving ability used in this research according to The National Council of Teachers of Mathematics (NCTM, 2000), namely: (1) constructing new mathematical knowledge through problem-solving, (2) solving problems that appear in mathematics and other contexts, (3) implementing and adapting a variety of suitable strategies to solve problems, and (4) paying attention to and reflecting on the process of solving mathematical problems.

RESULTS AND DISCUSSION

Before hypothesis testing, the data from the mathematical problem-solving ability test were first tested for normality and homogeneity. After testing normality and homogeneity in both groups, the results showed that the data of mathematical problem-solving ability of both samples came from a normally distributed population and had the same variance (homogeneous), so it could be continued with hypothesis testing.

The calculation of the hypothesis 1 test is used to test whether the experimental group's mathematical problem-solving ability test data can reach the limit of classical completeness, namely, students can achieve a minimum score of 70 with a percentage of more than or equal to 75%. Based on the calculation results, the $z_{calculate} = 1.687$ value is obtained. The value $z_{0.5-\alpha}$ with a$\alpha = 5\% = 0.05$ is 1.64. Because of $z_{calculate} = 1.687 > 1.64 = z_{0.5-\alpha}$ then H_0 is rejected. This means that the mathematical problem-solving ability of experimental group students has reached classical learning completeness. So, based on the results of research on hypothesis 1, it shows that the ability to solve mathematical problems in the STAD learning model assisted by question cards reaches a minimum learning completeness of 75%, namely 28 out of 32 students achieved individual completeness or 88% of students who took the problem-solving ability test exceeded the KKM. This can be achieved because, in the experimental group, students get more practice problems both in groups and individually. Giving problems in the form of question cards makes students not feel bored in solving problems on the question card. In addition, with the award for students who get the highest score, students also try to solve the problems given.

The calculation of the hypothesis 2 test was conducted to test whether the average test of students‘ mathematical problem-solving ability with STAD learning assisted by question cards was higher than the average test of students’ problem-solving ability with conventional learning. Based on the results of the mathematical problem-solving ability test, the average of the group that received STAD learning assisted by question cards was 79.97 with the lowest score was 50 and the highest score was 100. From the mean difference test, the value of $t_{calculate} = 3.644$ and t_{tabel} with $dk = (32 + 32 - 2) = 62$ is 1.999. Because $t_{calculate} = 3.644 > 1.999 = t_{table}$ then H_0 is rejected. That is, the average test results of students' mathematical problem-solving ability in STAD learning assisted by question cards is more than the average test results of problem-solving ability in conventional learning.

The calculation of the hypothesis 3 test was carried out to test whether proportion of students who were complete in solving ability in the STAD learning model assisted by question cards was more than proportion of students' mathematical problem-solving ability in the conventional learning model. From proportion difference test obtained $z_{calculate} = 3.64$ and $z_{\frac{1}{2}-\alpha}$ with $\alpha = 5\% = 0.05$ is 1.64. Because $z_{calculate} = 3.64 > 1.64$ then H_0 is rejected. That is, proportion of completeness of mathematical problem-solving ability in STAD learning assisted by question cards is more than proportion of completeness of conventional learning’s mathematical problem-solving ability.

Learning motivation questionnaires were distributed to experimental group students who received the STAD learning model assisted by question cards at the end of the meeting. Based on the Likert scale calculation of learning motivation questionnaire, the results show that 22% of students have learning motivation in the high category, as many as 6 out of 32 students; 66% who have learning motivation in the moderate category, as many as 22 out of 32 students; and 13% who have learning motivation in the low category, as many as 4 out of 32 students. Based on these results, two research subjects were taken, each representing each category of learning motivation so six research subjects were obtained. The research subjects in the STAD class assisted by question cards can be seen in Table 2. After conducting quantitative data analysis and making a category for student learning motivation, the next is qualitative data analysis.

Table 2. Research Subject

No	Student Code	Learning Motivation Category	Research Subject Code
1	E-23	High	T-1
2	E-30		T-2
3	E-08	Moderate	S-1

4	E-11		S-2
5	E-09	Low	R-1
6	E-27		R-2

Students with high learning motivation, namely subject T-1 and subject T-2 have high mathematical problem-solving ability. Subject T-1 and subject T-2 can answer 3 questions given and 3 questions answered correctly. The results of the qualitative analysis of the mathematical problem-solving ability of students in the high learning motivation group show that subject T-1 and subject T-2 can fulfil four indicators of mathematical problem-solving ability, namely constructing new mathematical knowledge through problem-solving, solving problems that appear in mathematics and other contexts, implementing and adapting a variety of suitable strategies to solve problems, and paying attention to and reflecting on the process of solving mathematical problems.

Students with moderate learning motivation, namely subject S-1 and subject S-2 have moderate mathematical problem-solving ability. Subjects S-1 and S-2 answered the 4 questions given correctly. However, subject S-1 and subject S-2 did not fulfil the indicators of paying attention to and reflecting on the progress of problem-solving in question number 3.

Students with low learning motivation namely subjects R-1 and R-2 have low mathematical problem-solving abilities. Subjects R-1 and R-2 tend to be able to fulfil the indicators of constructing new mathematical knowledge through problem-solving. So it can be said that subjects with low learning motivation are able to understand problems well. Subjects with low motivation tend to be unable to fulfil the indicators of solving problems with other contexts, using various appropriate steps to solve, and observing and reflecting on the progress of problem-solving. Subject R-1 and subject R-2 fulfilled the indicator of solving problems with other contexts in items number 1 and 3. Subject R-2 did not fulfil using various appropriate steps to solve for all items, while subject R-1 could fulfil for items number 2 and 3. The indicator of paying attention to and reflecting on the progress of problem-solving could be fulfilled by subject R-1 for items number 1 and 3, while subject R-2 only for item number 1.

CONCLUSION

Based on the results of research and discussion of mathematical problem-solving ability in terms of students' learning motivation in Student Teams Achievement Division (STAD) learning assisted by question cards, the following conclusions are obtained. (1) Students' mathematical problem-solving ability of class VIII after participating in STAD learning assisting with question cards has reached learning completeness; (2) Students' mathematical problem-solving ability with the application of the STAD learning model assisted by question cards is better than the mathematical problem-solving ability of students in the control class. (4) Students with high learning motivation have better mathematical problem-solving ability than students with moderate and low learning motivation. This is because high learning motivation subjects are able to fulfil the four indicators of mathematical problem-solving ability well fibre is able to solve problems correctly and precisely using systematic solution steps. Learners with moderate mathematical problem-solving ability have moderate problem-solving ability. This is because the subject is able to fulfil three indicators of mathematical problem-solving but the subject cannot reflect on the results of his work. Meanwhile, students with low mathematical problem-solving ability have low mathematical problem-solving ability. This is because the subject can only fulfil one indicator of mathematical problem-solving ability, namely constructing new mathematical knowledge through problem-solving.

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