The Practicality of the Problem Posing Approach with the STAD Setting in Mathematics Learning

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Abstract

This research aims to determine the practicality of the problem-posing approach with the STAD setting in mathematics learning. Practicality can be seen based on the implementation of learning by the teacher and student responses. This research is development research that focuses on producing a problem-posing approach design with an STAD setting. The subjects of this research were 8th-grade students. The data collection instruments used in this research were teacher observation sheets and student response questionnaires. Problem posing approach STAD setting used in this learning includes (1) identifying learning objectives and motivating students, (2) forming groups, (3) presenting problems, (4) proposing new problems based on the problems given, (5) guiding students' answers by evaluating the problem-solving process (6) feedback back and, (7) give appreciation. The research results show that the learning design implementation is in the good category, and students' responses to the learning process are in the positive category. Thus, the problem-posing approach with the STAD setting in mathematics learning is in the practical category.

Keywords: *Practicality; Problem Posing; Mathematics; Reasoning.*

Abstrak

Tujuan dari penelitian ini adalah untuk mengetahui kepraktisan pendekatan problem posing bersetting STAD dalam pembelajaran matematika. Kepraktisan dapat dilihat berdasarkan keterlaksanaan pembelajaran oleh guru dan respon siswa. Penelitian ini merupakan penelitian pengembangan yang berfokus untuk menghasilkan desain pendekatan problem posing bersetting STAD. Subjek penelitian ini adalah siswa SMP kelas VIII. Instrumen pengumpulan data yang digunakan dalam penelitian ini adalah lembar observasi guru dan angket respon siswa. Pendekatan problem posing bersetting STAD yang digunakan dalam pembelajaran ini meliputi (1) mengidentifikasi tujuan pembelajaran dan memotivasi siswa (2) pembentukan kelompok (3) penyajian masalah (4) mengajukan masalah baru berdasarkan masalah yang diberikan (5) membimbing jawaban siswa dengan mengevaluasi proses penyelesaian masalah (6) umpan balik dan, (7) memberikan penghargaan. Hasil penelitian menunjukkan bahwa keterlaksanaan desain pembelajaran berada dalam kategori baik dan respon siswa terhadap proses pembelajaran adalah berada dalam kategori positif. Dengan demikian pendekatan problem posing bersetting STAD dalam pembelajaran matematika berada dalam kategori praktis.

Kata Kunci: Kepraktisan; Problem Posing; Matematika; Penalaran.

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INTRODUCTION

One of the process standards that students need to have in learning mathematics is reasoning (NCTM, 2000). Reasoning is a process or thinking activity to draw a conclusion (Leighton, 2004) or a thinking process to make a new, true statement based on several statements whose truth has been previously proven or assumed (Gultom et al., 2022). Reasoning in mathematics is very important in a person's thinking process. Through reasoning, students are expected to see that mathematics is a logical subject. Students feel confident that mathematics can be understood, thought about, proven, and evaluated and that reasoning is needed to do things related to mathematics (Hasanah et al., 2019). However, mathematical material will be easily understood through reasoning, and reasoning skills can be trained through learning mathematics (Gultom et al., 2022).

The emphasis on reasoning in school mathematics instruction is due to its key role in meaningful learning (Ball & Bass, 2003) and the recognition of the value of engaging students developmentally appropriately (McCrory & Stylianides, 2014). Reasoning in mathematics is a basic mathematical ability needed for several purposes, such as understanding mathematical concepts, using mathematical ideas and flexible procedures, and reconstructing. Through reasoning, students can become capable communicators, creators, critical thinkers, and collaborators (Sumarsih et al., 2018). Therefore, teachers must be able to help students improve and develop their mathematical reasoning abilities.

Although reasoning in mathematics is very important in a person's thinking process, the situation in the field still needs to be under the expected goals, and the reasoning abilities of Indonesian students still need to improve. The 2018 PISA reports inform that Indonesian students' mathematics knowledge and skills still need to be improved compared to other countries. In PISA 2018, around 71% of students still needed to reach the minimum competency level in mathematics. These results show that many Indonesian students still need help dealing with situations that require problem-solving skills using mathematics. Students only have level 1 competency by being able to answer mathematical questions in a general context where all the information and questions are very clear and use mathematical formulas directly. Students at this level can work on clear math problems, such as reading a value from a simple graph or table with the labels on the graph or table exactly matching the editorial in the question. However, they usually cannot do arithmetic calculation problems that do not use whole numbers or questions with instructions that are not clear and well-detailed (Kemdikbud, 2019).

Several previous research results also reinforce students' lack of mathematical reasoning abilities. Aprilianti & Zanthy (2019) revealed that most students (above 50%) have mathematical reasoning abilities in the low category. Reasoning abilities are low because students need to understand the questions better, need to improve at identifying and organizing data in formulas (Fisher et al., 2019), and are less able to conclude a statement (Muslimin & Sunardi, 2019). These results indicate that students have difficulty understanding mathematical material because their reasoning abilities have not developed well; this is caused by a learning process that does not support or facilitate the development of reasoning abilities (Mariyam & Wahyuni, 2016). Teachers do not provide or present problems that can develop students' mathematical abilities.

Based on this phenomenon, it is necessary to make improvements in learning that can facilitate students in developing their mathematical reasoning abilities. Developing students' mathematical reasoning abilities can be done using the right learning approach. Problem-posing is one type of student-centered learning that helps students develop their reasoning abilities. Voica & Pelczer (2010) stated that learning is related to mathematical understanding and reasoning, which is problem-posing learning. Mestre (Christou et al., 2005) also expressed that problem posing is learning that will stimulate students in identifying knowledge, reasoning, and developing concepts.

Brown & Walter (2005) stated that problem-posing provides opportunities for students to think freely and independently in solving problems so that anxiety can be overcome in learning mathematics through problem-posing. Brown and Walter (2005) describe problem posing in 2 perspectives of cognitive activities:

accepting (accepting) and challenging (challenging). Accepting activities occur when students read the situation or information provided by the teacher, and challenging activities occur when students try to ask questions based on the situation or information provided.

The study results show that the problem-posing approach positively affects mathematics learning. The problem-posing approach can create a positive attitude toward mathematics learning (Akay & Boz, 2010). Problem-posing learning is effective in reasoning abilities (Novia et al., 2018; Nurhikmayati, 2018). The problem-posing approach improves students' reasoning abilities (Sugandi, 2018) and is better than conventional learning (Mahmuzah & Aklimawati, 2017). Abramovich & Cho (2008) and Cankoy & Darbaz (2010) state that there is a relationship between problem-posing and problem-solving. Other research also reveals that problem-posing can arouse students' mathematical interest and abilities (Xia et al., 2008).

Stoyanova and Ellerton differentiate between problem-posing situations depending on the level of structure, namely free, semi-structured, and structured problem-posing (Harpen & Presmeg, 2013). The choice of problem posing used in this research is structured problem posing. Structured problem posing is posing questions by creating a new problem based on the problem given by the teacher and solving the problem. In structured situations, people are asked to raise further concerns based on a particular problem by varying the conditions (Baumann & Rott, 2021). So, this form of problem-posing is done by reformulating the problem with several changes to make it simpler and more understandable to solve the problem.

The problem-posing approach can be done individually or cooperatively. According to Permana (2011), mathematics problems posed individually do not contain intervention or thoughts from other students. This problem is purely the result of thoughts motivated by the given situation. Mathematical problems posed and solved by students cooperatively can have more weight, especially concerning the problem's completion level. Therefore, problem-posing is set in cooperative learning to support learning and involve students actively. The cooperative learning used in this research is the Student Teams Achievement Divisions (STAD) cooperative learning model. A cooperative structure of tasks, goals, and rewards characterizes STAD-type cooperative learning. In implementing this learning, students are assigned to work in small groups of 4 to 5 people; each group must be heterogeneous regarding gender, ethnicity, and academic ability (Chairuddin & Farman, 2021).

RESEARCH METHODS

This research is development research oriented towards preparing learning designs structured problem posing that can improve students' mathematical reasoning abilities. Development research is research that produces a product with valid, practical, and effective criteria. The development of learning design using a problem-posing approach with a STAD setting is based on the ADDIE model. The ADDIE model is an acronym for five different process phases, namely Analyze, Design, Development, Implementation, and Evaluation (Farman, 2023). In the analysis stage, designers conduct formative assessments in which learners are analyzed to identify their characteristics (e.g., prerequisite knowledge, previous experiences, interests) and to determine instructional goals. During the design phase, learning milestones are identified to guide the creation of a content outline and the selection of learning strategies. Apart from that, it also considers instructional methods, types of learning activities, task analysis, and various types of media and technological tools selected in the design phase. In the development phase, designers create prototypes for instruction and design or select existing assessment instruments. During the implementation phase, learning materials and assessments are delivered, supporting and strengthening students' mastery of learning. The final phase is the evaluation implementation process (Khalil & Elkhider, 2016).

The trial subjects in this development research were 8th-grade students at SMP-TQ Muadz Bin Jabal Kendari in the even semester of the 2017/2018 academic year. The data obtained from testing this development product is quantitative data and qualitative data. Quantitative data consists of scores obtained from teacher observation sheets and student response questionnaire scores. Meanwhile, qualitative data consists of responses and suggestions for improvement based on the results of assessments by practitioners and research subjects. The data collection instruments used in this research were teacher observation sheets and student response questionnaires. Teacher observation sheets are used to measure the implementation of the learning design developed. Student response questionnaires are used to measure students' opinions regarding learning activities.

Analysis of design practicality data was carried out by analyzing the results of observations of teacher activities and student response questionnaires. Analysis of teacher activity observations was carried out by calculating the percentage of the average score (AS) for each meeting. This average was then adjusted to the criteria: very good ($AS > 85$), good ($70 < AS \leq 85$), quite good ($55 < AS \leq 70$), poor ($40 < AS \leq 55$), and not good ($AS < 40$). Analysis of student questionnaire responses was carried out by grouping responses into positive (yes) and negative (no) responses. A student response is called positive if more than 50% of students say "yes", and conversely, a response is called negative if more than 50% of students say "no." Learning design is categorized as practical if the average teacher activity is at least good and student responses are categorized as positive (Farman & Chairuddin, 2020).

RESULTS AND DISCUSSION

In the analysis stage, information was obtained that most students had difficulty engaging in mathematical reasoning. Difficulties include the need for more use of problems as stimuli that can train students' mathematical reasoning activities. The learning carried out by the teacher is still teacher-centered, where the teacher carries out direct learning activities by being actively involved so that students have less of a role in learning. Students are passive in constructing their understanding to build new knowledge. Apart from that, the problems (questions) given in learning have yet to be able to help develop students' mathematical reasoning abilities. The questions given to students only contain routine questions that only develop students' knowledge and abilities in calculating. Thus, learning that not only revolves around the realm of knowledge and application but is capable of developing students' reasoning abilities is needed.

After identifying the problem and objectives, the design stage continues to identify learning approaches that can overcome the problem. One lesson that can help students learn actively and develop their thinking processes is problem-posing. Implementing the problem-posing approach will be more effective in a cooperative learning setting. The problem-posing approach in cooperatives provides space for students to think about posing problems based on the situations and problems given and find solutions. Problem-posing approach with STAD setting in this research is a lesson where the teacher gives several problems, and students in groups reformulate the problem with several changes to make it simpler and more understandable to solve the problem. The steps used in this learning include (1) identifying learning objectives and motivating students, (2) forming groups, (3) presenting problems, (4) proposing new problems based on the problems given, (5) guiding students' answers by evaluating the problem-solving process (6) feedback and, (7) giving awards. The activities of teachers and students at each learning step using the problem-posing approach set in STAD are presented in Table 1.

Table 1. Teacher and Student Activities in Learning

Phase	Teacher Activities	Student Activities
Identify learning goals and motivate students	a. Convey learning objectives b. Motivate students	Listen and study the teacher's delivery.
Group formation	a. Dividing students into heterogeneous study groups b. Explain the duties and responsibilities of group members	a. Students place themselves according to their groups. b. Pay attention to and understand the teacher's explanation of group duties and responsibilities.
Presentation of the problem	a. Providing information-seeking activities	a. Understand the problem, look for information

Phase	Teacher Activities	Student Activities
	(investigating) about the material under the learning objectives b. Provide questions in the form of problems to be solved	about the material, and ask questions that are not clear b. students understand the problem
File a new issue based on the given issue	a. Ask students to ask questions about the problem to support the answer to the problem. b. Allow students to solve the questions they ask.	a. Compose new questions from the problem that support the answer to the problem. b. Complete the questions he wrote.
Guiding and evaluating students' problem-solving processes.	a. Provide opportunities for students to discuss b. Guiding the group's answers to solve the problems that have been given c. Allow students to represent their groups to convey answers to the problems that have been discussed. d. Respond to the progress of the discussion	a. Actively discuss with group friends to complete group assignments. b. Resolve problems related to the given problem. c. One person representing the group provides answers to the problems that have been discussed. d. Pay attention to the response given by the teacher
Feedback	a. Direct students to make conclusions b. Provide quiz questions to be done individually	a. Make conclusions b. Do test questions individually.
Give awards	Reward individual and group learning outcomes in the form of praise or prizes.	Receive awards in the form of praise or prizes.

Subsequently, teaching and learning tools were developed to support the implementation of learning design in the context of the problem. In the development phase, the design of learning tools and instrument is validated by experts. In general, examiner validation results for laerning tools and instrument are considered valid. In addition to providing an assessment based on the content of the checklist, the validator also provides feedback and comments. The reviewer's ideas and notes will be used as a resource to modify the prototype.

After obtaining a valid learning device (prototype 2), the learning device is then tested in a learning activity in class (implementation stage). This second prototype was tested in class VIII SMP-TQ Muadz Bin Jabal Kendari for 10 lesson hours with a time allocation of 2 hours for each lesson at each meeting. The trial was carried out according to the design in the learning plan with a total of 32 students, who were divided into five groups with heterogeneous abilities. Implementing classroom learning involves observers using observation sheets to observe student performance and teacher performance during instruction. Then, at each meeting at the end of the lesson, students are given assignments and quizzes, which are done individually. The quiz results then become a guide for giving group awards through development scores. After learning the circle material is complete, a mathematical reasoning ability test is then carried out.

The evaluation stage describes the results of implementing the design that has been developed. The implementation of the learning design at each meeting Pi (meeting-i) and The results of the trial are presented in Table 2. Overall, the average implementation of the learning design is 85%. This shows that the teacher's activities are in the good category.

Student response data were obtained from questionnaires completed by students after the test. Analysis of student response data revealed that the average student response to the learning approach was 85% (see Table 3). These results indicate that students' responses to the learning approach are in the positive category.

Table 2. Observation Results of Teacher Activities

Observed Activity	P 1	P 2	P 3	P 4	P 5
Provide apperception related to the material to be taught	3	3	3	3	3
Communicate learning objectives	3	3	3	4	3
Motivate students	3	4	4	4	4
Convey the rules/problem-posing learning activities that are implemented	3	3	3	4	4
Organizing students in groups	4	3	4	4	4
Providing information-seeking activities (investigating) about material and examples under learning objectives	3	3	3	4	3
Ask each student to understand and discuss the problems given with their group friends	3	3	3	4	4
Direct students to discuss with their group friends to create new questions based on the problems given	3	3	4	3	3
Direct students to discuss with their group friends to solve the questions that have been created	4	3	4	4	4
Direct students to discuss with their group friends to solve problems	3	4	3	4	4
Ask students to present the results of group discussions	3	4	3	3	3
Ask students to respond to the results of the presentation and provide feedback	3	3	3	3	4
Give awards to the best groups	4	4	3	3	3
Guiding students to make conclusions from the material studied	3	4	3	4	4
Give homework to do at home	3	3	4	3	4
Give quizzes that are done individually	3	3	3	3	4
Total Score	51	53	53	57	58
Average implementation (%)	80	83	83	89	91

Table 3. Results of the Student Response Questionnaire

Indicator	Response (n)		Percentage (%)	
	Yes	No	Positive	Negative
Student motivation in learning	26	6	81.25	18.75
Student understanding	22	10	78.15	21,875
Learning atmosphere	28	4	87.5	12.5
discussion in learning	32	0	100	0
Use of student worksheets in learning	24	8	78,125	21,875
Average			85	15

Based on practicality criteria, the results of teacher activities and student responses show that the implementation of the design is included in the practical category. This is in line with the results of the study by Purnomo et al. (2015), which found that the teacher's ability to manage problem-posing learning is included in the very good criteria, and students provide good responses. Teachers can use a problem-posing approach to gain greater insight into students' mathematical understanding (Cai et al., 2013; Chua & Toh, 2022) and identify students' mathematical misconceptions (Koichu et al., 2013). The most important thing is that problems posed in the classroom positively influence teachers' beliefs about mathematics and mathematics learning (Barlow & Cates, 2006). In particular, problem-posing exercises can bring greater awareness of the relationship between the initial state and goal state of a mathematical problem and a better awareness of problem-solving strategies, knowledge, and processes of mathematical content. Problem posing as a classroom activity can offer a platform for students to overcome their fixation on problem-solving, where thinking is chained by previous knowledge and by organizing how to see things (Chua & Toh, 2022).

Apart from the problems above, an important thing that needs to be followed up and is still open for research is teacher knowledge in problem posing. It can be understood that teacher knowledge can influence students' understanding of concepts in problem-posing. The problem-posing process and teachers' challenges in problem-posing are also still something to be considered for study.

Teacher competence and knowledge in using and teaching problem posing are factors that influence students' understanding of concepts in problem posing. Teachers must have the capacity to generate and formulate problems to provide relevant activities for student learning (Lee et al., 2018). Teachers need to gain problem-solving experience if they want to facilitate new and different learning experiences for students (Singer & Voica, 2013). Teachers who are equipped with the necessary skills to pose problems with problem-solving strategies can easily succeed in teaching mathematics (Ünlü, 2017).

CONCLUSION

Problem-posing approach The STAD setting in this research is a lesson where the teacher gives several problems, and students in groups reformulate the problem with several changes to make it simpler and more understandable to solve the problem. The steps used in this learning include (1) identifying learning objectives and motivating students, (2) forming groups, (3) presenting problems, (4) proposing new problems based on the problems given, (5) guiding students' answers by evaluating the problem-solving process (6) feedback and, (7) giving awards. The problem-posing approach with the STAD setting in mathematics learning is in the practical category. This is shown by the average implementation of the learning design being 85% (good category) and the average student response to the learning process being 85% (positive category).

Considering that problem-posing activities play a more central role in the classroom, they should be included in the curriculum. However, when problem posing is included in textbooks and curriculum materials, the main significant activity remains in the classroom. Therefore, in teaching problem-posing effectively, teachers are advised to have comprehensive knowledge and experience in the problem-posing process.

This learning can be developed for other material and adjusted to achievement indicators to support the development of students' reasoning abilities or other abilities (e.g., communication skills, and creative thinking). This development only aims to overcome some problems in learning mathematics subjects. Other problems, such as low learning motivation and inadequate facilities and infrastructure, also need solutions by carrying out various innovative and sustainable efforts. Apart from that, problem posing can also be set in other cooperative learning models to see how it compares with this research.

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