

Improving Problem-Solving Ability Through Problem-Posing Model in Mathematics

Asri Dwita^{1,*} Sugiman²

¹ Graduate Program of Mathematics Education, Yogyakarta State University, Yogyakarta, Indonesia

² Mathematics Education Department, Yogyakarta State University, Yogyakarta, Indonesia

*Corresponding author. Email: asridwita.2019@student.uny.ac.id

ABSTRACT

Problem-solving ability is one of the most important aspects required in teaching Mathematics. This is because the ability can empower individuals to compete in the globalization era. Thus, this study intends to explore the probability of one of the learning models, Problem-posing, to enhance mathematical problem-solving ability. Several articles from reputable journals about the effectiveness and the effect of the problem-posing model are examined in this literature review. The method used is a systematic literature review. Several relevant articles from electronic databases search are used to be examined in this literature review. The result of the literature reviews exploring whether face to face learning or online learning shows that problem-posing learning probably improves students' mathematical problem-solving abilities by conducting active, creative, and independent learning.

Keywords: *Problem-Solving Ability, Problem-Posing Model, Mathematics*

1. INTRODUCTION

Education is an important aspect that contributes to improving the quality of human resources [1]. In the globalization era, education is needed to equip students with various abilities to face global competition [2]. Thus, the success in education is the beginning to form formidable generations building civilization. After the National Examination in Indonesia was abolished, currently the general assessment of learning and teaching is based on the results of PISA (Program for International Students Assessment). There are several fields of the study assessed by PISA, one of them is mathematics. Around 5 years ago, in 2015, [3] stated that the mathematics performance of Indonesian students was ranked 64 out of 65 participating countries. The average mathematics score of Indonesian students was 386 compared with the international average score achieving 500. In this case, one of the abilities is assessed as collaborative problem-solving.

The low problem-solving ability of students encourages educators to improve education quality. A teacher needs efforts to increase the quality of education. One of the efforts is by implementing high quality of teaching and learning. To achieve this, a learning model is required in the learning process. One of the learning

models probably used in learning mathematics is the problem-posing model [4].

Problem-posing is a learning model requiring students to compile their questions or break down a problem into simpler questions to solve the problem [5]. In other words, problem-posing refers to generate new questions [6]. Submission of questions by students is a learning activity supporting student-centered learning because it will encourage students to be actively engaged [7]. Moreover, students need to propose a problem by themselves to be able to know the meaning of questions [8]. Ali [9] states that forming questions can be done by looking at the formula of known questions then changing the information. This means that the problem-posing model is about proposing questions from the given problems by the learners. Therefore, it can be concluded that the problem-posing learning model demands students to formulate questions by themselves.

Based on [10], there are three types of problem-posing namely free problem-posing (students pose a problem by general direction), semi-structural problem-posing (students pose a problem by given stimulus), and structured problem-posing (students are asked to formulate problems by reformulating given problem). This states that students explore the problem with or without direction in problem-posing. Furthermore,

problem-posing begins with the problem in form of questions so that students have a desire to know through the learning process [11]. Based on these statements, it could be said that formulating a problem is required in problem-posing learning.

In implementing problem-posing learning, based on [12], students are trained to correlate information/situations with the material to be learned, trained to solve mathematical problems systematically, and trained to propose similar problems sharpening the concepts in their schemata. Thus, problem-posing is meaningful learning involving prior knowledge. This corresponds with the idea of [13] that one of the activities in one of the abilities, problem-solving ability, involves prior knowledge. Moreover, prior knowledge tends to assist in finding problem-solving strategies [14]. By these statements, it means that both problem-posing learning and problem-solving are related to prior knowledge. Therefore, problem-posing learning has the opportunity to improve problem-solving ability.

Based on the background above, it is shown that problem-posing learning has the opportunity to improve problem-solving ability. Thus, this literature review will examine the concepts, characteristics, and benefits of problem-posing to increase problem-solving ability. Furthermore, this literature review discusses the relationship between problem-posing model and problem-solving ability. The results of this study can be used as the teacher's reference in implementing problem-posing learning as an effort to improve students' problem-solving ability.

2. METHOD

This article is a literature review that aims to examine the improvement of problem-solving ability through problem-posing models. The method used in this literature review is a systematic literature review offered by [15]. Based on the method, the researcher proposes questions, identifies relevant sources, assesses the quality of the studies, summarizes the evidence, and interprets the findings. In this case, the questions to be asked are whether or not the problem-posing model can improve the student's mathematical ability. In this study, the relevant sources were obtained by finding as many relevant articles as possible, Research Gate, and International journals such as the International Journal of Instruction, and other national accredited journals. The two keywords used are 'problem-posing to increase problem-solving', 'problem-solving ability with problem-posing'. There is various assessment for articles used as sources in this literature review. First, this literature review focuses on articles that have empirical data. In this case, the search results obtained are in the form of relevant sources from empirical articles examining the effectiveness and effect of problem-posing models to increase problem-solving ability in mathematics. Second, the subject in this literature review is from elementary school to university to obtain a more comprehensive analysis. Third, the criterion for the publication of articles published is from 2000-2020 so that this literature review examines the latest articles as expected. Based on the three criteria above, there are five articles reviewed. The researcher has carefully reviewed these articles. After having the articles, then the researcher carefully summarizes the evidence and interprets the findings discussed in the result and discussion part.

3. RESULT AND DISCUSSION

There are five relevant articles analyzed in this study. The following Table contains the overview information related to the articles.

Table 1. Overview of Problem-Posing Learning Studies

Writer (Year)	Independent Variable	Dependent Variable	Research Design	Subject
Anifah, Ratna Dewi & Wahyudi (2020)	Problem Based Learning and Problem-posing Model	Problem-Solving Ability	<i>Quasi experimental</i>	Grade V Elementary School 2 Beringin
N.I Fajariyah & YL. Sukestiyarno & Masrukan & I Junaedi (2012)	Problem-posing and Creative Problem-posing model		Quasi experiment, Posttest Only Control Group Design.	Grade VIII D Junior High School 1 Tangenan
Firdayanti, Sheila Rosa & Filia Prima Arthalina & Veryliana Purnamasari (2019)	Problem-posing Model		One Group Pretest Posttest Design	Grade V Elementary School 1 Pleburan, Semarang
Himmah, Wulan Izzatul & Muhammad Istiqlal (2019)	Problem-posing Learning		Pretest-posttest Design	Grade VIIA on one of the junior high schools in Semarang
Suarsana, I Made & Ida Ayu Putu Diah Lestari & Ni Made Sri Mertasari (2019)	Online Problem-posing		Quasi-experimental research with post-test that only controlled group design	119 students grade 11 senior high school 4 Singaraja

Several studies have shown the effectiveness and effect of problem-posing learning towards problem-solving ability. In research [16], problem-posing was more effective than the other model in improving students' problem-solving ability. Furthermore, based on the results of the study, students do not only solve daily life problems but they also propose simple questions and solve the problems then collecting data to solve more challenging questions that they had already proposed. Furthermore, language structure in proposing questions is extremely to avoid unsolvable questions issues [17]. In this case, students solved non-routine problems. It is the reason why learning with the problem-posing model is better than the other implemented model.

[18] shows that the problem-posing model is effective to enhance mathematical problem-solving ability.

Learning in the class implemented problem-posing model is more effective than in the control class. By implementing the problem-posing model, students are given learning experiences so that they have a good understanding of the material and build their knowledge helped by teacher instruction. This because students easily understand the given problems by discussion. The good learning process is supported by forming heterogeneous groups that high ability students help low ability students to learn. Possibly happened based [19], in the discussion phase, teachers' challenges are managing students' participation, discussing insight mind, setting aside their truth or clarity, and constructing knowledge.

Moreover, [20] shows that the ability of problem-solving was increased while using the problem-posing model. In the study, the indicators of problem-solving

ability by using problem-posing learning were increased consistently from the first day to the fifth day of problem-posing learning. This improvement was due to the implementation of the problem-posing model which conducted students to discuss and express their respective opinions. This trains their mindset and courage to express their opinions in front of their friends.

The same thing also happens in research [21]. It is shown that problem-posing learning has the opportunity to improve students' mathematical problem-solving ability. Furthermore, the problem-posing model is better than conventional learning because it allows students to be active, creative, and independent in developing ideas. Students were actively involved by proposing questions and solving them by themselves based on the way they choose. This because the learning ability with problem-posing provides experience for students to solve non-routine problems to improve their mathematical problem-solving ability.

In research [22], interestingly, learning with online problem-posing is more effective than conventional learning or ordinary problem-posing learning in terms of students' mathematical problem-solving ability. In this case, problem-posing learning with online-based experimented almost the same as ordinary problem-posing class, but in class problem-posing learning with online-based, students were given the task by using Edmodo. It was given after learning activities in class. Besides it, online discussion regarding learning and assignments tended to be more flexible and motivated students to ask questions and explain their ideas. In the session, the teacher delivered feedback about their assignments. These are the reasons why online problem-posing learning is effective in terms of problem-solving ability.

Based on the analyzes above, it is shown that problem-posing learning has the opportunity to improve students' problem-solving ability. It is because problem-posing learning has a positive impact to improve problem-solving ability. Furthermore, indicators of problem-solving ability have increased. The following diagram illustrates the process of developing problem-solving ability through problem-posing learning based on the examined articles

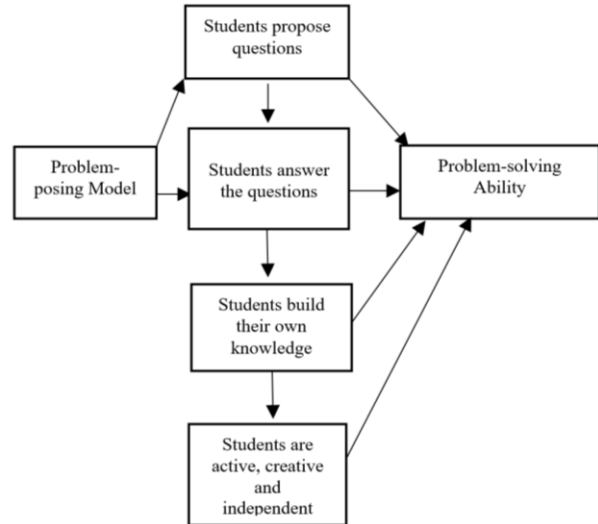


Figure 1 The Problem-Posing Learning Process that Improves Problem-Solving Ability

Based on the diagram, we can see that the problem-posing model has strong reasons to increase problem-solving ability. The problem-posing model demands students to propose and answer questions by themselves. First, students propose some questions. Then, students answer the questions. After having done this process, students establish their knowledge. These strengthen them to become active, creative, and independent people. Through those processes, the problem-solving ability of students can be developed.

4. CONCLUSION

Based on analysis results in this literature review, the problem-posing learning empowers active, creative, and independent learning to endeavor students solving non-routine problems so that it improves students' problem-solving ability. Problem-posing learning encourages students to be more active, creative, and independent by developing their ideas in mathematics learning [21]. The study [22] states that students' mathematical problem-solving ability in the classroom implemented problem-posing learning with online-based is *more effective than in the classroom applied ordinary problem-posing learning*. Thus, in general, it could be concluded that the problem-posing model can improve students' mathematical problem-solving ability. Furthermore, the problem-posing model towards mathematical problem-solving ability needs further research because just a few articles had explored it for twenty years.

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