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Research Article

Mind mapping with problem-posing: Can it affect student's problem-solving skills in Schoology-based learning?

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ABSTRACT

Problem-solving skills are essential to help students in expressing their ideas. However, problem posing is a method that can empower problem-solving skills. This study aims to determine the effectiveness of mind mapping assisted with a problem-posing method in online Schoology-based learning. This experimental research used the posttest-only control group. The subject of this study were students of the Department of Biology Education, 2020/2021 academic year, Universitas Sembilanbelas November Kolaka. The sample was divided into an experimental class and a control class. The research instrument was post-test questions that were made based on the indicators of problem-solving skills. The result showed that the experimental class has the highest score on each indicator of problem-solving skills. In addition, the hypothesis testing result with a significance p-value was 0.025 (<0.05). It can be concluded that there is a significant difference between the experimental class and the control class. The average value of problem-solving skills in the experimental class is also higher than in the control class. These results indicated that the mind mapping assisted with a problem-posing method in online Schoology-based learning is effective in improving students' problem-solving skills.

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INTRODUCTION

In learning, students need problem-solving skills to be able to compete globally, helping them make correct, logical, systematic decisions, and consider the problems from various angles (Amanso & Bassey, 2017; Priemer et al., 2020; Temel, 2015). Lambert (2019) explained that problem-solving skill is the ability to find solutions and express ideas through the process of obtaining and organizing information. According to Gagné (2010), problem-solving is the synthesis of rules and other concepts into high-level rules that can be applied to a limited situation. The learning process that involves students understanding real-world problems can improve the students' performance in everyday life. Using problem-solving skills, they can construct their

knowledge (Deiglmayr & Spada, 2011; Ruhalahti et al., 2017; Wang et al., 2013). So, problem-solving skills are one of the most needed skills in 21st-century education.

Problem-solving skill is one of the Higher Order Thinking Skills (HOTS) that is very important for students to face the challenges of the 21st century (Hugerat & Kortam, 2014; Osborne, 2013). HOTS learning-oriented is needed to measure and determine the readiness and ability of the students in higher thinking activities (Hugerat & Kortam, 2014). HOTS in learning can lead the students to get used to analyzing, reasoning, and being creative in solving problems found in everyday life (Kusuma et al., 2017). Problem-solving skill, as one of HOTS, is needed by students. When solving problems, students need the conceptual understanding skill to connect each concept (R. J. Sung et al., 2020). Besides, experience is also needed in solving problems. A problem is said to be the problem if its solution requires some understanding, creativity, and everyone's thinking or imagination when facing the problem.

Using problem-solving in learning can optimally improve student activities, such as exploration, observation, experimentation, and investigation. Utilizing problem-solving activities can facilitate students' understanding of the subject matter. As well as supporting media, methods or techniques to make them more active and independent (Bernard et al., 2018). There are problem-solving indicators as a reference in assessing the level. The problem-solving indicators used in this study are (1) understanding the problems; (2) planning; (3) implementing the plan; and (4) looking back at the problem-solving result. Problem-solving skill according to (Lestari et al., 2019) does not only require students to solve a problem in the way the teacher conveys, rather elaborate on their abilities to find the combination of rules that they have learned in advance and become a new way for them to consider the process of solving problems. It means that problem-solving skills, one of high-level thinking ability, are required for students to combine all their knowledge to solve problems.

Problem-solving skills can be empowered using a combination of learning methods, including problem-posing. This learning method aims to develop students' problem-solving skills because the questions and solutions of the problem-posing are designed by students themselves (Akben, 2020; Ngaeni et al., 2017; White & Sullivan, 2018). Problem-posing also develops students' cognitive activities, namely acceptance, and challenge. Acceptance occurs when the students read the information provided by the teacher. Meanwhile, the challenge occurs when the students pose the problems based on the information provided (Kopparla et al., 2019). The activity of asking questions in a group can also provide step-by-step instructions during the learning process (H. Y. Sung et al., 2013). The research results by Septian and Aulia (2021) show that the problem-posing method is better than direct learning in developing students' problem-solving abilities. Previously research on problem-solving skills had been carried out through the problem-posing method. For example, the effect of the problem-posing method on the problem-solving skills of elementary school students. The result of this study indicated that students who are taught using the problem-posing method perform better than students without intervention (Kopparla et al., 2019). Another study showed that problem-posing can empower students' problem-solving skills (Akben, 2020; Septian & Aulia, 2021).

Learning activity with the problem-posing method can take place effectively with a learning technique, namely mind mapping. Mind mapping is an activity that requires students to be involved in learning. Students can connect their previous knowledge with new information (Salomon & Perkins, 1998). They also summarize the material to be studied and project the problem encountered into the form of a map or graphic technique so that it is easier to understand (Wu & Wu, 2020). These activities also can be completed individually outside class time or in groups in the class (Israel et al., 2021). By using mind mapping, students are taught to be creative. They also make an effective note to provide a comprehensive view of the subject matter (Hariyadi et al., 2018).

However, learning today is affected by the COVID-19 pandemic (Kidd & Murray, 2020). The existence of COVID-19 has an impact on the learning process in schools and universities must be carried out online (Dwivedi et al., 2020). Every educational institution must adapt to these changes and choose the right technology and approach to educate and engage students in learning. During online learning, the role of educators is important, because they must utilize the technology to provide education (Carrillo & Flores, 2020; Dwivedi et al., 2020). The use of technology in online learning greatly supports the students' thinking skills in 21st-century learning. One of the technology-based online learning platforms is Schoology.

Schoology-based online learning is a Learning Management System (LMS) platform that combines the concept and social networking features (Budhiman et al., 2021). The features of Schoology are generally divided into three parts. First, a course is a facility to create the subject class. The second one is a group, which is the facility to create study groups. Then the last one is a resource which is a place to upload learning resources. On the course menu, the teacher can make questions in various forms, such as multiple-choice, short entry, matching, true-false, and description. It is also equipped with equation typing facilities, mathematical symbols, and pictures (Rinenggo & Murdiono, 2020). Setiawan and Aden (2020) found that

using Schoology can improve students' academic abilities. Then, Schoology was chosen to be one of the LMS used during learning in the COVID-19 pandemic.

Research on problem-solving skills through the problem-posing method has been done online. However, the research does not use mind mapping as a learning technique (Suarsana et al., 2019). In its development, the researcher adopted the importance of the problem-posing method assisted by mind mapping as one of the steps to empower problem-solving skills. During the pandemic, learning is carried out using the Schoology platform. Compared to previous research, this study combines mind mapping with problem-posing in Schoology-based learning. The problem-posing method strengthens this research on the importance of a learning method, especially in empowering students' thinking skills. By the problem-posing method, students can improve their problem-solving skills. Mind mapping is a technique to empower students' thinking skills. It is an alternative to help students solve the problems related to the phenomena that occur in everyday life. Then, the Schoology platform is used to facilitate the distribution of learning materials online.

METHOD

This research was conducted from March-June 2021 at the Universitas Sembilanbelas in November, Kolaka. The subject of this study was students of the Department of Biology Education. The experimental design used in this study was a simple experimental design with a posttest-only control group design. The design model is described in Table 1.

Table 1. The posttest-only control group design

Group	Treatment (X)	Post-test
R1	X	O1
R2	-	O2

Descriptions:
R1 = experimental group
R2 = control group
X = treatment (learning using the problem posing method assisted by mind mapping)
O1 = experimental group post-test
O2 = control group post-test

The influence of the independent variable on the dependent variable is measured by analyzing the posttest score of the experimental group (O1) and the control group (O2). If there is a difference in the score between the two groups, where the score in the experimental group (O1) is higher than the score in the control group (O2), it concludes that the treatment given has an effect or is effective on the changes that occur in the dependent variable. The test was given to the experimental class and the control class as a posttest to determine the students' achievement. The instrument used in the posttest was in the form of essay questions. The test preparation began with making a grid of questions, then continued with the description of questions, answer key, and scoring rule for each question. The students' problem-solving skills level is determined using problem-solving indicators which are adapted from Fuadi et al. (2017). The problem-solving skills indicator was assessed using a 0-5 scale converted to a 0-100 scale. Thus, the rubric can be seen in Table 2. The collected data is analyzed using unpaired t-test analysis assisted by SPSS 22 for Windows.

Table 2. The rubric and indicator of problem-solving skills

Indicators	Scoring Indicators	Score
Understanding the problems	Write down the things that are known and explain correct and complete	5
	Write down the things that are known and explain correct and incomplete.	3
	Write down the things that are known and explain incorrect.	1
	Do not write down the things that are known and explain at all	0
Planning for problem-solving	Write down the problem-solving strategies correct and complete.	5
	Write down the problem-solving strategies correct and incomplete.	3
	Write down the problem-solving strategies incorrect.	1
	Do not write down the problem-solving strategies at all.	0
Implementing the problem-solving plan	Write down the problem-solving process correct and complete.	5
	Write down the problem-solving process correct and incomplete.	3
	Write down the problem-solving process correct and incomplete.	1
	Do not write down the problem-solving process at all.	0
Looking back on the problem-solving result	Write down the checking problem-solving result correctly and completely.	5
	Write down the checking problem-solving result correctly and incompletely	3
	Write down the checking problem-solving result incorrectly	1
	Do not write down the checking problem-solving result at all	0

RESULTS AND DISCUSSION

The result showed that the students' problem-solving skills in experimental groups are higher than in the control group. The average results of each indicator on the problem-solving skills can be seen in Figure 1. Based on Figure 1, it is shown that there are differences in students' achievement in each indicator of problem-solving skills in the experimental and control group. The highest average score is in the indicator of understanding the problems. The experimental group reaches 53, while the control group is 46. In the indicator of planning for problem-solving, the average value of the experimental group is 51, while the control group reaches only 35. In the indicator of implementing the problem-solving plan, the average value of the experimental group (45) is also higher than the control group (29). The lowest average value was on the fourth indicator (looking back on the problem-solving result). The average score of the experimental group is 31, while the control group is only 22.

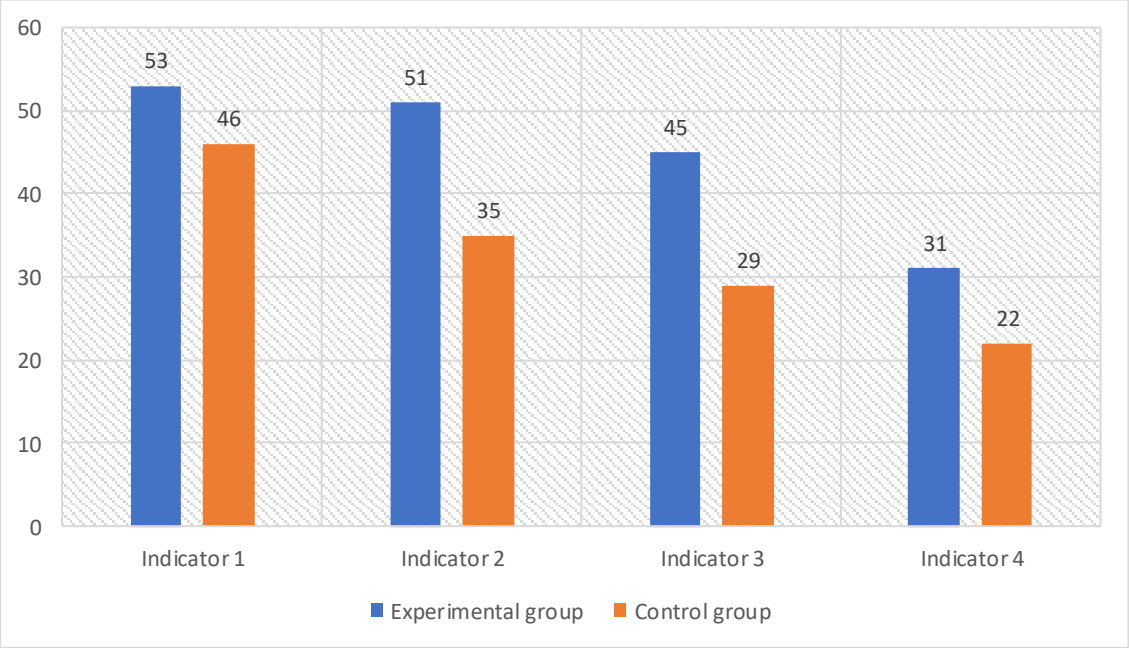

Figure 1. The average score for each indicator of problem-solving skills in experimental and control group

Furthermore, Table 3 shows the result of the normality test. It indicated that the level of significance value of problem-solving skills in the experimental class obtained a value of 0.06 and the control class obtained a value of 0.15. These results showed that significance value > 0.05, which means that the data is normally distributed.

Table 3. The result of normality test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Experimental group	.167	26	.060	.956	26	.318
Control group	.150	26	.136	.941	26	.141

Then, the unpaired sample t-test is conducted to determine the effectiveness of the mind mapping using the problem-posing method on students' problem-solving skills. The results of the t-test can be seen in Table 4. Based on Table 4, it can be seen that the value of significance is 0,025 (p-value < 0.05). It indicated that H0 is rejected and H1 is accepted. It can be concluded that there is an effect of the mind mapping assisted problem-posing method on students' problem-solving skills in Schoology-based learning.

Table 4. The result of unpaired sample t-test

		t-test for Equality of Means					
		df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Problem-solving	Equal variances assumed	50	.025	10.76923	4.67399	1.38125	20.15721
	Equal variances not assumed	49.992	.025	10.76923	4.67399	1.38122	20.15725

The problem-solving skills in the experimental group have significant differences from the control group. It can be explained theoretically and empirically. Judging from the theoretical basis, each stage of the problem-posing method can help students to develop their thinking skills. Thus, students' skill to solve a problem is better. While in the conventional learning method, learning is centered on the lecturer so that students are not actively involved in the learning process. Judging from the empirical basis, students who learn by using the problem-posing method equipped with a problem-posing worksheet can formulate questions to be solved in a group. By asking questions, students become trained in thinking so that it is easier to solve the problems. Afgani et al. (2016) stated that the questions prepared at the problem-posing stage helped to construct the knowledge possessed. According to Suarsana et al. (2019), designing problems from the information presented can encourage the students to develop thinking skills. The result of research conducted by Rasmianti et al. (2013), showed that the problem-posing method is very effective in developing student problem-solving skills. When formulating questions, students think analytically. It can make students master the concepts more stable.

The student performance in solving problems also affects their problem-solving skills. When solving the problem, they first must understand the problem. They try to solve the problem after understanding the problem in the learning process. According to Akben (2020), to propose and solve a problem, it is necessary to have a high level of abstraction and reflection so that they can build new knowledge. People who pose a problem are showing their ideas, while creative ideas are put forward during the problem-solving process. The result of Mahendra et al. (2017) study showed that the problem-solving process in the problem-posing method has a positive impact on students. At this stage, students solve the real problems. So, it is easier for them to understand the concept and solve it. The learning technique used during the learning process with the problem-posing method is mind mapping. The examples of students' mind mapping results uploaded to the Schoology platform can be seen in Figure 2.

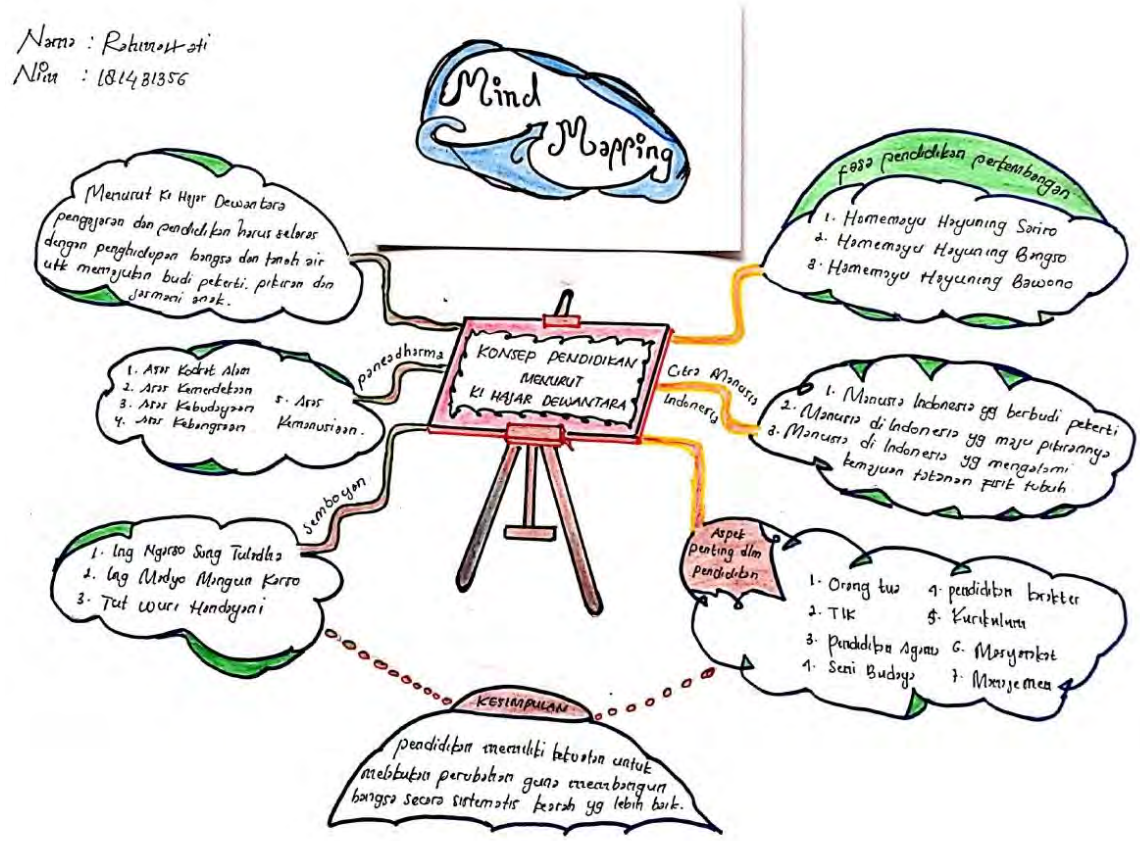

Figure 2. The example of students' mind mapping result

Based on the mind mapping result created by the students, it can be seen that the preparation of mind mapping is based on the main idea or main topic. In Figure 2, as an example, there are many branches related to the main topic. According to Purwaningsih (2017), the branching made in mind mapping can help students see the relationship between one idea and another. This can make it easier for the brain to understand and absorb the information. Mind mapping can develop students' problem-solving skills. When doing the mind mapping, they gain a comprehensive understanding to increase their initiative to learn. Israel et al. (2021) argue that mind mapping is a learning strategy that helps to organize, remember, analyze, and integrate information, all of which contribute to developing effective critical thinking skills. Inline with Wu and

Wu (2020) study, the combination of concepts made in mind mapping can increase learning efficiency, train memory, and process analytical skills.

Research conducted by Iswara and Sundayana (2021) showed that the problem-posing method has a positive impact on students' thinking skills. Some students are very enthusiastic about solving problems based on problem-solving. The results of research conducted by Dong et al. (2021) indicated that mind mapping can empower sustainable creativity among students. Students who get problem posing learning assisted by mind mapping have better problem-solving and reasoning abilities (Dong et al., 2021; Hariyadi et al., 2018; Ristiasari et al., 2012). Problem-posing combined with mind mapping can improve students' problem-solving and reasoning abilities. The learning process is carried out using the Schoology platform. Students log in to the Schoology account using the username and password that have been created. The draft display of online learning materials using e-learning Schoology can be seen in Figure 3.

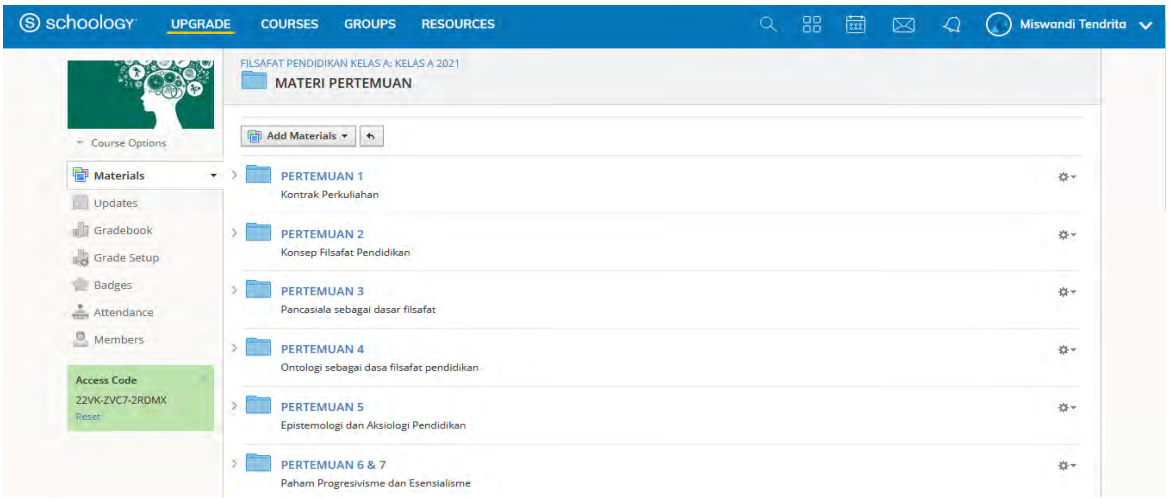

Figure 3. Meeting preview in Schoology platform

In Figure 3, it can be seen that the lecturer creates a folder at each meeting so that students can know the materials to be studied. It is easier for students to download the materials and upload the problem-posing and their mind mapping sheets. According to Rinenggo and Murdiono (2020), using Schoology can make the learning process more innovative. Schoology enables educators to produce, manage, and share the materials (Budhiman et al., 2021; Rinenggo & Murdiono, 2020). By using Schoology, students can learn and access the materials online (Anggraeni et al., 2020). Several previous research results had shown that online learning based on Schoology can increase the students' motivation and students thinking skills (Anggraeni et al., 2020; Budhiman et al., 2021; Rinenggo & Murdiono, 2020; Setiawan & Aden, 2020; Wahyudi, 2017).

In the problem-posing method, students ask questions to find knowledge to find relationships in the information learned. The discovery of questions and answers generated in the problem-posing method can lead to changes and dependence on external reinforcement on satisfaction due to the success of finding their own, either in the form of questions or problems or answers to the problems posed (Akben, 2020). The activity of asking questions can empower problem-solving abilities. According to Ngaeni et al. (2017), this learning method helps develop students' problem-solving skills because they design the problem and its solutions.

Questions on the problem-posing sheet are uploaded to Schoology in the task folder section. Wahyudi (2017) state that the attractiveness of e-learning learning programs with Schoology makes students enthusiastic about involving themselves in learning activities. This condition causes the knowledge they get from the learning experience stored in long-term memory. Each student makes a mind map. Making mind maps helps them get ideas. Students become more creative in expressing knowledge or their opinion. The mind mapping created is then uploaded to the assignment folder in Schoology to be checked by the lecturer. Mind mapping provides opportunities for students to develop ideas further creative in developing the working potential of the brain and its mindset. So, students' understanding of concepts and communication skills in solving the problem will be better.

CONCLUSION

The research result finds that the problem-posing method assisted by mind mapping affects students' problem-solving skills in Schoology-based learning. The result showed that there is a significant difference between the experimental and control group in problem-solving skills scores (with a p-value < 0.05). Although

learning is carried out online by utilizing the Schoology online platform learning, the learning process is still carried out well. It can be seen from the way students pose the questions, solve the problems, and make mind mapping based on the main idea. The result of this study can be a solution to develop students' problem-solving skills.

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