



The Influence of the Problem Based Learning Model assisted by Mind Mapping on the Cognitive Learning Outcomes of High School Students on Respiratory System Material

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Abstract

Respiration material is material that is difficult to understand because the material coverage is broad. Learning cannot yet require students to be active and train students to discover concepts independently. The aim of this research is to analyze the influence of the Problem Based Learning model assisted by Mind Mapping on the cognitive learning outcomes of high school students in the respiratory system material, analyze student responses, and analyze teacher responses to the application of the Problem Based Learning model assisted by Mind Mapping. This research design is quasi-experimental with a nonequivalent control group design. The population in this study was class XI students at SMAN 12 Semarang and the sampling technique was purposive sampling. The sample in this study was students in class XI F-2 (experimental class) and XI F-4 (control class) with 34 students in each class. Student cognitive learning outcomes were measured using test instruments in the form of pretest and posttest questions in multiple choice form, then analyzed using the classical learning mastery test, t-test and N-Gain test. Teacher responses were measured using interview instruments and student responses using a questionnaire sheet. The results of the classical learning completeness test in the experimental class were 100% with the number of students who completed it, while in the control class it was 67.6% with the number of students who completed it as many as 23 people. The results of the t-test analysis on the pretest showed that there were no significant differences between the experimental and control classes, while the t-test analysis on the posttest showed that there were significant differences between the experimental and control classes. The results of the N-Gain test showed that the increase in cognitive learning outcomes in the experimental class was in the high category at 0.77, while the control class was in the medium category at 0.38. The teacher's response to the Problem Based Learning model assisted by Mind Mapping was very good because it was effective in achieving learning outcomes and objectives, student responses showed a positive or good response to the learning carried out. The conclusion of this research is that there is an influence of the Problem Based Learning model assisted by Mind Mapping in improving the cognitive learning outcomes of class XI students on the respiratory system material and getting a positive response from teachers and students.

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INTRODUCTION

The rapid development of science and technology has an impact on various fields, including education. Education must prepare quality and highly competitive human resources to meet the needs of the 21st century (Munthe, 2020). One effort to develop student competence is to increase joint learning. Quality learning can be improved by creating an active, innovative, creative and fun learning atmosphere.

Respiratory system material is a topic ranked 1st in the difficult to understand category with a percentage of 54.5% (Fauzi & Mitalistiani, 2018). Based on the results of interviews with biology teachers at SMAN 12 Semarang, students often have difficulty understanding the process of transporting O₂ and CO₂ as well as the mechanisms of external and internal respiration. Students experience difficulties in studying the respiratory system material because there are many foreign terms that are difficult to understand and the coverage of the material is very broad.

The Problem Based Learning learning model is a student-centered learning model so that students can collaboratively solve problems faced in real life and can obtain essential knowledge and concepts from learning material (Astuti, 2019). The Problem Based Learning model links students' previous knowledge and experience with the real world context that students will face, and various facts and ideas surrounding the problems presented, so that at the end of the Problem Based Learning lesson the expected learning outcomes are achieved (Wulandari et al., 2014). The Problem Based Learning model is effective in developing scientific literacy skills and providing opportunities for students to critically examine contextual problems related to scientific concepts (Aliyana et al., 2019). The Problem Based Learning model can improve student learning outcomes in the cognitive, affective and psychomotor domains (Wulansari et al., 2019). This is in line opinion with Mulyani (2020); Subekti & Nugroho (2019); Susilowati et al (2017); Sugiani (2018) stated that Problem Based Learning can improve the quality of the learning process and student learning outcomes.

The Problem Based Learning learning model assisted by Mind Mapping is a problem-based learning model assisted by mind maps. Students are required to solve problems, relate them to learning objectives and present them in the form of Mind Mapping. The Problem Based Learning learning model assisted by Mind Mapping is very good to apply in learning because it will make students more active in learning while the teacher only serves as a facilitator, so that students can build their own knowledge and students can apply new knowledge in the form of mind maps (Megawati et al., 2018). The application of the Problem Based Learning learning model assisted by Mind Mapping tasks can encourage students to build biological concepts well and improve students' creative thinking skills (Sumarta, 2017). It is hoped that the learning process assisted by Mind Mapping can make students active, constructivist, creative and communicative in learning biology so that they can obtain satisfactory learning results.

Based on the background above, it is necessary to conduct research to analyze the influence of the Problem Based Learning model assisted by Mind Mapping on cognitive learning outcomes in the respiratory system material, high school student responses, and teacher responses.

RESEARCH METHOD

The research was carried out at SMAN 12 Semarang which is located on Jalan Raya Gunungpati, Plalangan Village, Gunungpati District, Semarang City, Central Java. The research was carried out in the even semester of the 2023/2024 academic year in January-February.

The type of research used is experimental research. The form of design used in this research is quasi experimental with a nonequivalent control group design. In this research, there are two groups that will be given treatment, namely the experimental group that will be treated using the Problem Based Learning model assisted by Mind Mapping and the control group that will be treated using the lecture method. The population in this study were all students in class XI MIPA at SMAN 12 Semarang. The sampling technique in this research used a purposive sampling technique. Purposive sampling technique is a technique for determining research samples with certain considerations. Sampling was carried out based on the opinions or suggestions of the biology teacher concerned. The sample in this study were students in class XI F-2 and XI F-4.

RESULTS AND DISCUSSION

Results

Students' cognitive learning outcomes are obtained from the pretest and posttest results. The following is a recapitulation of students' cognitive learning outcomes in the experimental class and control class.

Table 4.1 Recapitulation of Cognitive Learning Results

Information	Experimental Class		Control Class	
	Pretest	Posttest	Pretest	Posttest
The number of students	34	34	34	34
The highest score	65	100	80	90
Lowest value	20	75	25	50
Average	47.5	88.1	49.7	70.9

Based on table 4.1, it can be seen that the average student learning outcomes during the posttest were much better than during the pretest. Apart from that, it can be seen that the average student learning outcomes during the posttest in the experimental class were higher than those in the control class. This is influenced by the application of the Problem Based Learning model assisted by Mind Mapping in the experimental class.

The pretest and posttest results are then used for the classical learning mastery test, t-test, and n-gain test. The learning result data was analyzed to determine classical learning completeness and the results showed that the number of students who completed the experimental class was 34 people with 100% classical completeness, while the number of students who completed the classical class was 23 people with classical completeness 67.6%.

Furthermore, the cognitive learning result data was also analyzed using an independent sample t-test to determine whether there were differences in the posttest results for the experimental class and the control class. Based on the t-test results, it was found that the sig value was 0.000 or smaller than 0.05, so H_a was accepted and H_o was rejected. This means that there is a significant difference in student learning outcomes between the experimental class and the control class. To determine the magnitude of the increase in students' cognitive learning outcomes before and after being given treatment, an N-Gain test was carried out. The results of the N-Gain test show that the increase in cognitive learning outcomes of students in the experimental class obtained a high category of 0.77 while the control class obtained a medium category of 0.38. So it can be concluded that the increase in learning outcomes in the experimental class is higher than in the control class.

Based on interviews conducted with biology teachers at SMA Negeri 12 Semarang, the application of the Problem Based Learning model assisted by Mind Mapping on the respiratory system material received a positive response. The results of the teacher response interviews are presented in the following table.

Table 4.2 Teacher Response Results

No	Main Question	Teacher Response
1	Effectiveness	It is effective because through the application of the PBL model students can achieve learning goals and good target grades
2	Excess	The advantage of the PBL model is that it can improve students' thinking abilities and activeness because learning is linked to everyday phenomena
3	Lack	The drawback related to time management is that it uses more time during learning compared to the lecture method
4	Interest	Very interested because it can make it easier for students to understand learning concepts
5	Criticism and suggestions	For learning respiration using the PBL model assisted by Mind Mapping by researchers, it is good because the learning model used is appropriate to the material

Giving student response questionnaires aims to determine students' responses to learning material on the respiratory system using the Problem Based Learning model assisted by Mind Mapping. The following is a recapitulation of the results of student responses.

Table 4.3 Recapitulation of Student Response Results

Based on the table above, it was found that learning carried out using the Problem Based Learning

NO	STATEMENT ITEMS	QUESTION SCORES/NUMBER OF RESPONDENTS WHO ANSWERED					TOTAL SCORE	MAXIMUM SCORE	AVERAGE (%)
		1	2	3	4	5			
		1	Interest	0	0	3			
2	Curiosity	0	0	4	22	8	140	170	0,824 (82,4%)
3	Concept understanding	0	0	7	20	7	136	170	0,80 (80,0%)
4	Ease of understanding the material	0	0	7	23	4	133	170	0,782 (78,2%)
5	Relating it to everyday phenomena	0	0	9	17	8	135	170	0,794 (79,4%)
6	Solution to problem	0	0	11	20	3	128	170	0,753 (75,3%)
7	Active opinion	0	0	11	21	2	127	170	0,747 (74,7%)
8	Creative	0	0	2	23	9	143	170	0,841 (84,1%)
9	Group collaboration	0	0	11	17	6	131	170	0,771 (77,1%)
10	Suitability of the learning model to the material	0	0	6	21	7	137	170	0,806 (80,6%)
AVERAGE (%)									79.6

model assisted by Mind Mapping received a positive/good response from students.

DISCUSSION

Based on the results of the classical completeness test, the results showed that classical completeness in the experimental class was higher than in the control class. Apart from that, through the independent sample t-test, the results showed that there was a significant difference between the learning outcomes of experimental class students who used the Problem Based Learning model assisted by Mind Mapping and the control class which used the lecture method. In this research, N-Gain analysis was also carried out and the results showed that the increase in learning outcomes in the experimental class was higher than in the control class. This can happen because of the application of the Problem Based Learning model assisted by Mind Mapping in the experimental class. This is in line with research by Herlina et al (2016) which states that the Problem Based Learning model is able to improve student learning outcomes because it is able to create meaningful understanding for each student.

The Problem Based Learning model is implemented through 5 syntaxes, namely problem orientation, organizing students, guiding investigations, developing results, and analyzing and evaluating the problem solving process. At the problem orientation stage, the teacher gives students stimulating questions that are related to everyday phenomena. Presenting questions related to everyday phenomena can increase students' interest and curiosity, so that through the learning process carried out it can lead to meaningful understanding for students (Lestari & Aziz, 2022). At the organizing and investigation stage, students are invited to be more active in exploring information and have problem-solving abilities in learning through group discussion activities so that students will be able to deepen and increase knowledge that was not previously known (Yusuf et al., 2020). At the results development stage, students present the results of their group discussions and receive feedback from the audience. Finally, after students have had discussions and found information independently, the teacher's job is to evaluate and provide reinforcement for the learning or discussions that students have carried out. Through the five syntaxes of Problem Based Learning, learning will increase interaction between teachers and students or interactions between students.

Based on the questionnaire obtained, students thought that learning using the Problem Based Learning model assisted by Mind Mapping was able to generate interest in learning and help students understand the concepts of the material more easily. The Problem Based learning model is a learning model that is student-

centered and the teacher's role is only as a facilitator so that students can discover their own knowledge. This is in accordance with research by Farisi et al (2017) which states that improving student learning outcomes is supported by the Problem Based Learning model which guides students to independently explore information related to learning.

Learning activities in experimental classes are inversely proportional to classes that only use the lecture method, in learning the teacher dominates and students are only passive listeners. Learning using the lecture method makes students unable to discover concepts independently and only focuses on the information presented by the teacher. This is in line with research by Kurniawan et al (2020) which explains that learning using the lecture method cannot arouse students' curiosity and reduces students' interest in learning.

In this research, the Problem Based Learning model was integrated with Mind Mapping so that it could improve student learning outcomes. This is in line with research by Rizali (2019) which states that the note-taking technique using Mind Mapping can improve learning outcomes and creativity because it can help students visualize, organize and connect the information they have obtained during learning. Mind Mapping is a technique for briefly or specifically recording information that has been obtained during learning. Mind Mapping is made with simpler sentences or language, making it easier for students to remember and re-study the material that has been taught during learning (Zubaidah et al., 2017). Mind Mapping consists of keywords, images and branches that can help students connect material concepts.

Based on the results of analysis of biology teacher responses at SMA Negeri 12 Semarang, teachers gave positive responses to learning carried out using the Problem Based Learning model assisted by Mind Mapping. Through the application of the Problem Based Learning model, teachers will not dominate learning so that students are more active in learning or discussion activities. Using Mind Mapping as a note-taking technique is also very effective because students are able to express the results of their understanding during learning in the form of simple sentences, so that when students review the lesson again it will be easier to understand it. The biology teacher at SMAN 12 stated that the Problem Based Learning model has several advantages, including increasing student activity, improving critical thinking skills, and helping students understand material concepts. This opinion is in accordance with research conducted by Suryandari (2016) which states that the Problem Based Learning model is able to increase students' interest in learning, enthusiasm for learning and thinking abilities.

CONCLUSION

Based on the results of the research and discussion, it was concluded that the application of the Problem Based Learning model assisted by Mind Mapping had an effect on improving the cognitive learning outcomes of high school students on the respiratory system material and received a positive response from students and teachers.

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