



The Effect Of Problem Based Learning On Students' Critical Thinking Abilities On The Human Digestive System Material

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Abstract

This study aims to determine the effect of the problem based learning model on students' critical thinking skills on the digestive system material. This study uses a quantitative method with a quasi experimental approach. The research design used is a two group pretest posttest. The study population includes all students of class eighth-grade of SMP Negeri 5 Medan, which consists of 11 classes. The research sample was selected using a simple random sampling technique, class VIII-4 as the experimental class and class VIII-3 as the control class. The research employed a critical thinking skills test instrument consisting of 25 multiple-choice questions. Hypothesis testing was conducted at a significance level of 0.05 with the assistance of Microsoft Excel. The results showed that the Problem Based Learning model had an effect on students' critical thinking skills. This was evidenced by the higher average posttest score of the experimental class (86.97 ± 5.85) compared to the control class (80.48 ± 6.66). The obtained N-gain value was 0.57, which falls into the moderate category. These findings indicate that the problem based learning model influences students' critical thinking skills on the topic of the human digestive system at SMP Negeri 5 Medan.

Keywords: : problem based learning, critical thinking skills, the human digestive system

INTRODUCTION

The 21st century is marked by rapid developments in science and technology (iptek). This has had a significant impact on all aspects of community life. This century has seen significant changes in the vision, behavior, knowledge, skills, and lifestyle of humans on earth (Fu'adi, Sudira, & Astuti, 2022). Learning in the 21st century aims to prepare graduates with the ability to master complex communication thinking skills and the ability to solve problems relevant to needs (Octaviani, Handayani, & Hamer, 2019).

The US-based Partnership for 21st Century Skills (P21) identifies critical thinking skills, creative thinking skills, communication skills, and collaboration skills as competencies needed in the 21st century (Danilaev & Malivanov, 2020). The demands of 21st-century educational competencies encompass various areas such as critical thinking skills, problem-solving skills, innovation and creativity, communication skills, collaboration

skills, and the ability to understand, operate, and utilize technology effectively (Imamah & Muqowim, 2020).

The 2012 Program for International Student Assessment (PISA) survey showed that Indonesian students' rankings lagged far behind other countries. Indonesia was ranked 69th out of 81 participating countries. Indonesia's PISA scores in 2022 showed that mathematics had a score of 366, reading 359 and science 383. These scores were significantly lower than in previous years, such as the science score, which in 2018 was 396, dropping to 383 in 2022. This score decreased significantly. Based on these PISA scores, it can be seen that students' thinking skills in Indonesia are still below average and still in the category of needing major improvement (Rodriguez & Lieber, 2020).

Critical thinking is undervalued because the learning process in schools is still dominated by teacher memorization, so students' critical thinking skills are not trained. Therefore, students need to be introduced to and trained in problem solving to further improve their critical thinking skills (Fauzi & Abidin, 2019), who stated that PISA questions require problem-solving skills and reasoning skills. A student can be said to be able to reason if he can apply his knowledge to new conditions that are unfamiliar to him. This ability is commonly known as critical thinking skills. Critical thinking is an intellectual thought process that assesses the quality of clear, reflective, rational, and independent thinking (Simanjuntak, Siregar, & Manurung, 2024).

The optimal achievement of students' thinking skills can be determined through the selection of learning models. An alternative learning model capable of developing students' critical thinking skills is the problem-based learning (PBL) model (Joshi, Desai, & Tewari, 2020). The problem-based learning (PBL) model can have a positive influence on improving students' critical thinking skills (Pujianti & Rusyana, 2020). The problem-based learning model is a learning model that begins with authentic (real-life) problems that are relevant to the material, thus training students to think actively in solving problems.

The results of previous research conducted by (Kholidah, Azizah, & Nilamsari, 2023) with the research title of the influence of the PBL learning model based on practicum on the critical thinking skills of grade VIII students in science learning, stated that the average final critical thinking ability score of students who used the PBL model based on practicum was 88.9 while the average final score of students who used the conventional model was 73.9 so that there was a difference of 15 values indicating a significant increase in value.

Based on observations and interviews with a science teacher at SMP Negeri 5 Medan, he stated that the learning model is still dominated by teachers using the lecture method. This method causes students to feel bored during learning activities. During the learning process, students are passive with the lecture method used. Students are also less active when responding to teacher explanations of the subject matter (Rizal Abdurrozak, Asep Kurnia Jayadinata, & Isrok'atun Isrok'atun, 2016).

This problem results in students' abilities and understanding not being optimal, which results in low grades or below the Learning Objective Achievement Criteria (KKTP) set by the school, which is 75. There are approximately 25 out of 35 students whose daily assignment and test scores are still below the KKTP (Rachmawati, Suhery, & Anom, 2017). The average grades in science subjects are 70 and 65. In addition, during the learning process, only a few students are seen expressing opinions regarding the material. Students still answer teacher questions in the form of simple statements without supporting evidence and reasons (Waluyo & Nuraini, 2021).

Discussion activities and interactions between students and students with teachers are also less intensive, which shows that students have not been trained to argue and students also find it difficult to understand the digestive system material in science learning because this material is classified as a complex biological system, requires problem solving because it is relevant to everyday problems and requires analysis and evaluation of information from students so that students' reasoning understanding is more developed (Daryanes, Darmadi, Fikri, & Sayuti, 2023). Based on this description, researchers are interested in conducting research entitled "The Effect of Problem Based Learning on Students' Critical Thinking Skills on Human Digestive System Material at SMP Negeri 5 Medan".

METHOD

The research was conducted at SMP Negeri 5 Medan, located at Jl. Stasiun Desa Besar, Martubung, Medan Labuhan District, Medan City, North Sumatra 2025. This research was conducted in the 2024/2025 academic year.

The population is the entire object of research, whether in the form of people, objects, events, values, or things that occur. The population in this study was all 8th grade students at SMP Negeri 5 Medan, totaling 342 students consisting of eleven classes in the 2024/2025 academic year, as seen in (Pebriyani & Pahlevi, 2020)..

The sample in this study consisted of two classes, referring to the sampling process where each member of the population had an equal opportunity to be selected (class random sampling). The first class served as the experimental class, taught using a problem-based learning model, and the second class served as the control class, taught using a lecture (conventional) model.

This study used a quasi-experimental approach. The study applied a problem-based learning model to the first grade and a conventional learning model to the second grade, then compared the two classes. The study was conducted in two different classes: the first grade as the experimental class and the second grade as the control class . The research design used in this study was a pretest-posttest control group design. This design was used to determine the effect of problem-based learning on students' critical thinking skills (Muhammad, Septian, & Sofa, 2018).

RESULTS AND DISCUSSION

Research result

The Influence of the PBL Model on Students' Critical Thinking Skills

The learning outcome test was used to measure students' critical thinking skills using the problem-based learning (PBL) model. Based on the student learning outcome data obtained during and after the research, and after the data was tabulated, the average, standard deviation, and variance of the pretest and posttest data for both the experimental and control classes were obtained, as shown in Table (Park, Lee, & Choi, 2025).

Table 1. Pretest and posttest data for the Control and Experimental Classes

Class	N	Mean		posttest	Std. Deviation
		Pretest	Std. Deviation		
Control	33	67	4.80	80.48	6.66
Experiment	35	68	4.65	86.97	5.85

Based on the table, there is a difference in the average achieved by the control and experimental classes. In the control class, the average pretest score was 67 and the average posttest score was 80.48, while in the experimental class, the average pretest score was 68 and the average posttest score was 86.97. This means that the experimental class had a higher average score than the control class.

Based on the table above, it can be seen that the pretest score for the experimental class was higher than the pretest score for the control class, although the difference was not significant. Furthermore, it can be seen that neither the pretest scores for the experimental nor the control class reached the completion threshold. The t-test showed that the initial abilities of students in the experimental and control classes were similar (Safrida & Kistian, 2020). The results of the study showed an increase in the average critical thinking ability score for students in the experimental class, which was higher than in the control class, as seen in the following figure (SALSABILA & MUQOWIM, 2024).

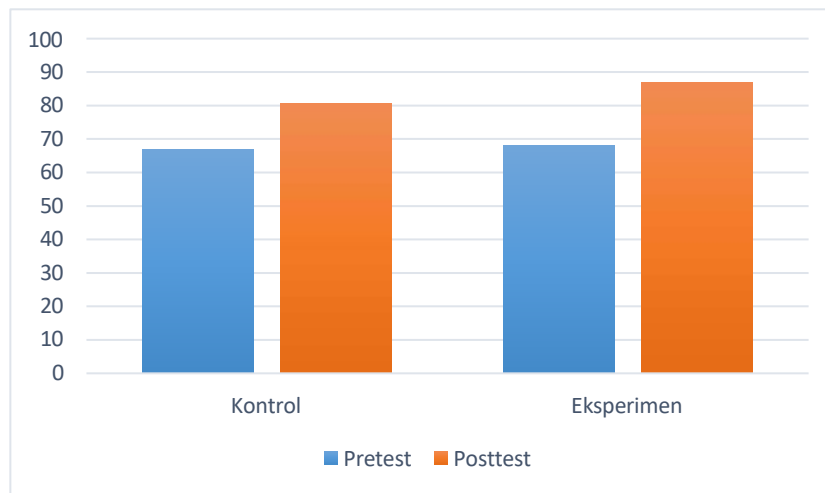


Figure 2. Diagram of Increasing Critical Thinking Skills

The data normality test is intended to determine whether the analyzed data is in the form of a normal sheet or not. The normality test uses Microsoft Excel with the following test criteria: $D h itung \leq D tabel$ then the table is normally distributed. Meanwhile, if $D h itung > D tabel$ then the sample is not normally distributed. Based on the results of the normality test using the Liliefors test listed in table 4.3 using a significance level of $\alpha = 5\%$ for $n = 33$ in the control class with a value of $D tabel = 0.154$ and $n = 35$ in the experimental class with a value of $D tabel = 0.149$. In the control class, the value of $D h itung$ in the pre-test was 0.144 and the value of $D h itung$ in the post-test was 0.149. Thus, $0.144 < 0.154 = D h itung < D tabel$ in the pre-test of the control class, it can be concluded that the data is normally distributed. Meanwhile, $0.149 < 0.154 = D h itung < D tabel$ in the post-test of the control class, it can be concluded that the data is normally distributed (Muna & Mujianto, 2023).

In the experimental class, the value of $D h itung$ in the pre-test was 0.147 and the value of $D h itung$ in the post-test was 0.122. Thus, $0.147 < 0.149 = D h itung < D tabel$ in the pre-test of the experimental class, it can be concluded that the data is normally distributed. Meanwhile, $0.122 < 0.149 = D h itung < D tabel$ in the post-test of the experimental class, it can be concluded that the data is normally distributed. Therefore, all data that has been tested in both the experimental and control classes are both normally distributed so that they meet the requirements for conducting further tests (Gong, Liu, You, & Yin, 2021).

The homogeneity test was conducted to determine whether the sample class came from a homogeneous population or not, meaning that the sample used in the study could represent the entire population or not (Huang, Hwang, & Jong, 2022). The results of the pre-test and post-test of the experimental and control classes were checked for homogeneity using the two variance equality test with the Fisher (F) method with the help of Microsoft Excel.

Based on table 4.4 above, which is a Microsoft Excel calculation for this homogeneity test, it can be seen that the F_{hitung} in the pretest data in both classes is 1.06389 while the F_{tabel} is 1.78304, namely if $F_{hitung} < F_{tabel}$ then it can be concluded that it is homogeneous. Meanwhile, the posttest data in both classes is 1.33774 while the F_{tabel} is 1.78304

Hypothesis Testing

After successfully fulfilling the prerequisite tests or the data is normal and homogeneous, the next stage is to test the hypothesis (Awaludin, Wibawa, & Winarsih, 2020). This test is conducted using a right-tailed t-test. The t-test is conducted to test the significance of the difference in averages between groups, in order to determine whether the research hypothesis is accepted or rejected (Ebrahim & Brown, 2022). The hypothesis in this study is that the critical thinking skills of students taught using the Problem Based Learning (PBL) learning model are more influential than those taught using the conventional model. The results of the hypothesis test analysis can be seen in Table below.

Table 2. Hypothesis Test Results

Second Class Data	t_{hitung}	t_{tabel}	Information
$\bar{x}_1 = 86.97$			
$\bar{x}_2 = 80.48$			
$S_1 = 35$	4,259	1,669	H_a accepted and H_0 ditolak
$S_2 = 33$			
$N_1 = 5.85$			
$N_2 = 6.66$			

Based on the hypothesis testing criteria, the value of t_{hitung} is 4.259 while the value of $t_{tabel} = 1.669$ can be interpreted as the value of $t_{hitung} > t_{tabel}$, then H_0 is rejected and H_a is accepted so it can be concluded that the critical thinking skills of students who are taught with the Problem Based Learning (PBL) learning model have an influence on the critical thinking skills taught with the conventional model (Abdulrozzak, 2016).

Improving Critical Thinking Skills

The N-gain test of research data aims to measure students' understanding after being taught. Before learning with the existing learning model, students were first given a pretest of 25 multiple-choice questions to assess their initial abilities. Then, at the end of the session, students were given a posttest with identical questions to assess their critical thinking skills. The calculation results showed an increase (Ariyani, 2021).

The learning outcomes (N-Gain) were 0.57 (57%), which are briefly presented in Table 4.6. The results of the normalized N-gain test calculations for pretest and posttest data can be seen in Appendix 26.

Table 3. N gain test results

Group	pretest	posttest	N	N - Gain	Information
Experiment	63.4	83.57	25	0.57	Currently

Discussion of Research Results

Based on the findings of this study, students' critical thinking skills on the human digestive system material taught using the problem-based learning model on critical thinking skills are higher than students' learning gains with conventional learning. The same research findings were also obtained by Mahardika, (2022) "There is an influence of the problem-based learning model based on practice on the critical thinking skills of class VIII students at SMP Negeri 9 Jember, it is known that the research results obtained are that 72% of students are able to work on critical thinking questions well which are obtained from the post-test scores" (Nawati, Yulia, & Khosiyono, 2023).

Based on the t-test sample test that has been carried out, the results of t_{hitung} are 4.259 and t_{tabel} are 1.669, which means that $t_{hitung} > t_{tabel}$ ($4.259 > 1.669$), so H_a is accepted and H_0 is rejected or there is an influence, meaning that PBL model learning has been proven to have an influence on students' critical thinking skills. The selection of the PBL model has an effect on students' critical thinking skills, which is also stated in research (Hardiantiningsih, Istiningsih, & Hasnawati, 2023) that the results of the independent sample T-test showed a significant difference in critical thinking skills between the experimental and control classes ($t=2.458$; $p=0.017$) so that the PBL model was proven to significantly improve students' critical thinking skills (Ayu, Marhaeni, & Budiadnyana, 2018).

Based on the average posttest score data, the results of critical thinking of students who were taught with the problem based learning model were higher than those taught with the conventional model. The average student learning outcomes after the application of the PBL learning model were seen based on the posttest scores, namely in the experimental class obtained a score of 86.97 and in the control class obtained a score of 80.48. The improvements that occurred due to being given a learning model treatment by following the syntax of the PBL learning model will certainly make students enthusiastic about learning and make those who were initially passive become active in exploring themselves both in terms of communication and thinking power, students become enthusiastic about conveying arguments and responding to each other's group ideas reflectively with their group mates on the problems given (Agustin Mutia, 2021)..

The information processing process that occurs will be stronger so that students digest learning materials more quickly and the memories they get become more solid, this is what is meant by meaningful learning. This is in line with Nurfrahrani's (2023) research, her research describes activities in the learning model, the ideal learning model that must create an active learning atmosphere so that interactions occur between teachers and students with other students. Because of this problem of learning activity, a teacher needs to choose the right model to stimulate student enthusiasm in learning because the stages in PBL do require students to be active so that this will increase their responsiveness or reasoning which has an impact on improving learning outcomes (Pebriyani & Pahlevi, 2020).

The selection of the PBL learning model is able to encourage students to actively think, seek information and discuss in solving problems related to science material. To support the application of this model, student worksheets are used that contain real problems regarding the components of the digestive system (Agustin Mutia, 2021). PBL learning is a learning model that uses real-world problems as a context for students to learn about problem-solving skills and to acquire knowledge and concepts from the subject matter. The application of PBL is able to motivate students in the problem-solving process (Maharani, Hadiyan, & Murdiyanto, 2021). Because science learning emphasizes the scientific problem-solving process, the appropriate learning approach is Problem-Based Learning (PBL). This model fully integrates the stages of the scientific method, namely: formulating hypotheses, designing experiments, conducting experiments, measuring data, analyzing results, and drawing conclusions and in this case all are contained in the stages of the PBL learning model. PBL learning and science lessons also have continuity where science requires learners to be able to learn independently and PBL is like a means of the stages to train students to be skilled at active learning. This is also in accordance with the opinion of Jumini (2022), who said that problem-based learning is the main method that is centered on students that provides individual skills to be able to learn independently and can help them find alternative solutions to problems they face in everyday life.

Improvement in student learning outcomes on the subject of the digestive system is also found in the results of Ningsih's research, (Megawati, 2021) the results of her research showed that the average learning outcomes obtained in this study for the control class were 68.74 while in the experimental class it was 77.38. From this further strengthens that this model is quite effective in applying science material. Students in learning if in this study is proven again through observations of their learning activities. The initial step in problem-based learning is to directly confront students' minds with everyday life such as events they usually witness and experience, problems commonly encountered in everyday life as a medium for the student learning process so that students will feel more interested in learning. This is in line with Ariani's research (2020) which states that the use of the problem-based learning model has a positive impact on the learning process in the classroom, students are motivated in the learning process so that student learning outcomes become

better. This is also supported by research by Khairunisa (2024) and Sutrisma (2022) which shows that there is an increase in student learning outcomes after learning using the PBL model. In addition, other studies such as Herzon (2018) and Habibah (2016) also revealed that the use of the PBL model has been proven to improve learning outcomes and achieve learning completeness because it is accompanied by an increase in students' thinking skills and communication skills during learning and significantly increases students' learning motivation (Kurniawati & Ekayanti, 2020).

This can be further explained in research that has been conducted in the control class, namely by using a conventional learning model where the teacher is the center of learning, making students tend to be more passive students sitting and paying attention to the teacher explaining the learning material (Indriyani, Mawardi, & Wardani, 2019). If students only listen and rely on what the teacher explains, there is a lack of interaction between students regarding their cognitive levels, so that the knowledge gained by students tends to be limited to the students themselves (Wahyuni & Anugraheni, 2020). This approach, although efficient, often emphasizes a one-way transfer of knowledge from teacher to student, without providing enough space for the exploration of ideas, in-depth discussions, or independent problem solving—things that are essential for practicing critical thinking (Delita, Rasyid, & Sugandi, 2022). As a result, students may be adept at memorizing and repeating material, but are less trained in evaluating, comparing, or creating new solutions based on in-depth understanding.

CONCLUSION

Based on the research results and discussion, the following research conclusions were obtained:

1. Based on the hypothesis test, the problem-based learning model has an effect on students' critical thinking skills on the human digestive system material at SMP Negeri 5 Medan.
2. Based on the N-Gain test, there was an increase in students' critical thinking abilities in the class that was given treatment of 0.57 with a moderate category.
3. The problem based learning model has been implemented well, with an average implementation value of 95% and is in accordance with the PBL syntax.

Suggestion

Based on the results and conclusions above, suggestions for further improvements can be given as follows:

1. For teachers and prospective teachers, it is hoped that they can apply learning using the problem-based learning model more broadly and in-depth, especially on material that requires conceptual understanding and student activity, such as material on the human digestive system.
2. It is recommended that students always pay attention to the teacher's instructions and be more active in group discussions in order to achieve an increase in thinking skills

on the human digestive system material after the problem-based learning model treatment in class VIII students at SMP Negeri 5 Medan.

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