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Problem based learning and intrapersonal intelligence: Effect on the problem-solving ability of human reproductive system material

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ABSTRACT

Problem Based Learning (PBL) is a learning model that encourages students to solve problems. At the same time, intrapersonal intelligence is a skill needed by students in solving problems so that students can solve problems well. This research aims to determine the effect of the Problem Based Learning (PBL) model and intrapersonal intelligence on high school students' problem-solving skills. The method used was an experiment with a quasi-experimental research type and a 2x2 factorial design—multistage random sampling sample selection technique. All students of class IX reach the population at SMAN 1 Baros. The target population for all class IX of SMAN 1 Baros is 130 students. The research sample consisted of 2 classes IX for the experimental class and two classes IX for the Control class, each of which totaled 65 students. The instrument for the ability to solve problems in the form of description questions consists of 11 items and intrapersonal intelligence in a questionnaire totaling 25 statements. Data analysis and hypothesis testing using two-way ANOVA with the help of the SPSS 21.0 software program. The results showed that the PBL model and intrapersonal intelligence significantly affected problem-solving skills with a sig < 0.05. The data analysis conclusion shows that there is an influence of the PBL model and the intrapersonal intelligence of high school students on the material of the human reproductive system.

Introduction

Biology learning in the 21st century contributes to the development of technology and education. The demands of 21st century learning for the world of education make students have the potential to be useful people in their environment (Ristanto et al., 2018). There are several skills and potential that every student in the 21st century must have, including learning to assess and follow up on problems by developing problem-solving skills that occur in their environment (Mishra & Mehta, 2017). The ability to solve problems is the ability of students to use various thought patterns that involve the process of integrating various knowledge to get the best answers

(Mourtos et al., 2004; Sadipour et al., 2017). The process of solving problems can be defined as the ability to take the necessary steps to achieve certain goals (Supiandi & Ege, 2017). The process of solving problems can be applied by giving a problem that exists in the student's environment. Giving real problems about biological material can be put to good use to answer the demands of the 21st century for education (Djamahar et al., 2018).

According to Ristanto et al. (2018) and Rosamsi et al. (2019), learning biology material is composed of many memorizations. Biological material includes abstract physiology that takes time to memorize (Nisa et al., 2015; Suhendar & Wahyuni, 2018). Abstract biology material is difficult to visualize (Jayawardana, 2017). The characteristics of this biological material are one of the reasons the teacher presents the lecture method in learning (Djamahar et al., 2018). The lecture method is the teacher's strategy of providing material with the aim that students can understand, memorize, and master complex biology material. The material of the human reproductive system is material that is very closely related to life. Various problems contained in the reproductive system material need to be constructed and solved through the learning process. For example, in the case of pre-eclampsia disorders, which are rarely mentioned in the learning process, even though these abnormalities are very high risk for pregnant women themselves and for the development of the fetus (Rusdi et al., 2012).

The accuracy of choosing a learning model is an alternative for developing students' problem-solving skills in biology material. Problem based learning (PBL) is a learning model that presents real problems to the students. They search for various kinds of solutions that are close to their environment. Furthermore, according to Aninda and Suryadarma (2017), the PBL model is appropriate for use in biology subjects. Biological characteristics and PBL are related. PBL prepares students to be able to solve problems with appropriate sources. Students search for various kinds of solutions by constructing their knowledge (Purnamaningrum et al., 2012). Through PBL learning, students get their knowledge not only by just remembering but also by understanding the material by solving learning problems (Hariatik et al., 2017; Noviar & Hastuti, 2015).

According to Lopes et al. (2020), real problems that are close to the student environment in PBL learning are contexts for making students learn to solve problems. The process of solving problem in PBL can encourage students to empower various thinking skills in order to obtain problem information (Corebima, 2016). PBL to make students are the main actors in learning (Savery, 2006), and students are required to be able to solve problems (Hung, 2016; Jonassen, 2011). The use of Problem-based learning models has been previously researched on the concept of learning biology. Several research results reveal that in PBL learning students can find and solve problems, thus stimulating to analyze, evaluate and create (Abdurrozak et al., 2016; Astuti et al., 2019; Sucipto, 2017).

The process of solving problems in learning using PBL requires intelligence. According to Slavin (2006), intelligence can be defined as a general talent for learning or the ability to learn and use knowledge or skills. Snyderman and Rothman (1987) define intelligence as the ability to face abstractions to solve problems and to learn. One of the student intelligences needed is intrapersonal intelligence. It is the interaction that occurs in students' thoughts or feelings in determining activities. Intrapersonal intelligence is an understanding of oneself, related to strengths, weaknesses, and things that are important. According to Li et al. (2013) intrapersonal intelligence is one of the intelligences to be able to understand himself, recognize his strengths, weaknesses and desires. Wijaya and Sudarmin (2016) state that students who have intrapersonal intelligence are students who are able to collect information, plan, choose and determine strategies using their knowledge, carry out planning steps, be independent, and work hard to solve problems.

Based on these descriptions, it is necessary to prove the influence of the PBL model and intrapersonal intelligence on the problem-solving abilities of high school students on the material of the human reproductive system. This prove was done as an effort to improve the problem-solving skills of the human reproductive system at SMA Negeri 1 Baros.

Method

The research method used is experiment, quasi-experimental research type and 2x2 factorial research design (Table 1), consisting of 2 independent variables, namely the Problem Based Learning (PBL) model (X1) and intrapersonal intelligence (X2), while the dependent variable is the ability to solve problems (Y).

Table 1. Factorial Research Design 2x2

Intrapersonal Intelligence (B)	Class (A)	
	Experiment (A1)	Control (A2)
High (B1)	A1B1	A2B1
Low (B2)	A1B2	A2B2

Note:
A1B1 = The result of problem-solving ability with PBL model which has high intrapersonal intelligence.
A1B2 = The result of problem-solving ability with PBL model which has low intrapersonal intelligence
A2B1 = The result of problem-solving ability with STAD model, which has high intrapersonal intelligence.
A2B2 = The result of problem-solving ability with STAD model, which has low intrapersonal intelligence.

This research was conducted at SMAN 1 Baros in the academic year of 2019/2020. The sample selection technique used was multistage random sampling. The population is affordable, and the target is all class IX students of SMAN 1 Baros. The sample in the study consisted of two class IX as the experimental class and two class IX as the control class, each of which totaled 65 students. The instruments used were test and non-test instruments. The test instrument used to measure the problem-solving ability consists of 11 essay items that refer to understanding the problem, planning, implementing the plan, and Re-checking.

The non-test instrument in the form of a questionnaire used to measure intrapersonal intelligence consists of 25 items developed through a grid and refer to indicators of recognizing oneself, knowing what one wants, and knowing what is important. Analysis of normality data used the Kolmogorov Smirnov test, homogeneity using the Levene's test, and two-way ANOVA hypothesis testing with the help of the SPSS version 21.0 software program.

Results and Discussion

The results showed that the highest average value was found in the experimental group (Table 2), student with ability high intrapersonal intelligence and learning using PBL (A1B1) have highest score of 78.56. The lowest average value is in the control group students who learn with the STAD model with low intrapersonal intelligence (A2B2) 67.67.

Table 2. Statistical descriptions of the results of solving the problem

Group data	N	Max score	Min score	Mean
A1	36	88	55	74.47
A2	36	85	50	69.86
B1	36	88	60	75.97
B2	36	82	59	69.02
A1B1	18	88	65	78.56
A1B2	18	82	55	70.39
A2B1	18	85	60	73.39
A2B2	18	75	60	67.67

Value of problem-solving ability in experiment class (A1) and control class (A2).

The results of this study indicate that the group of students in the experimental class using the PBL model and the control class using STAD obtained different mean scores. The ability to solve problems using the PBL model obtained higher scores with an average of 74.47 than the group of students who studied using the STAD model with an average of 69.86. This study is in line with Setyoko et al. (2019) that the ability to solve students' problems using the PBL model is better than those using the control class model because students' PBL model learning is oriented to be active in solving problems.

Table 3. Statistical data on the problem-solving ability of indicators in the experimental class (A1) and the control class (A2)

Criteria	Experiment (A1)	Control (A2)
Mean	73.41	69.64
Mean Max	83.33	77.00
Mean Min	65.00	64.25
Standard deviation	8.210	5.754
Varian	67.41	33.10

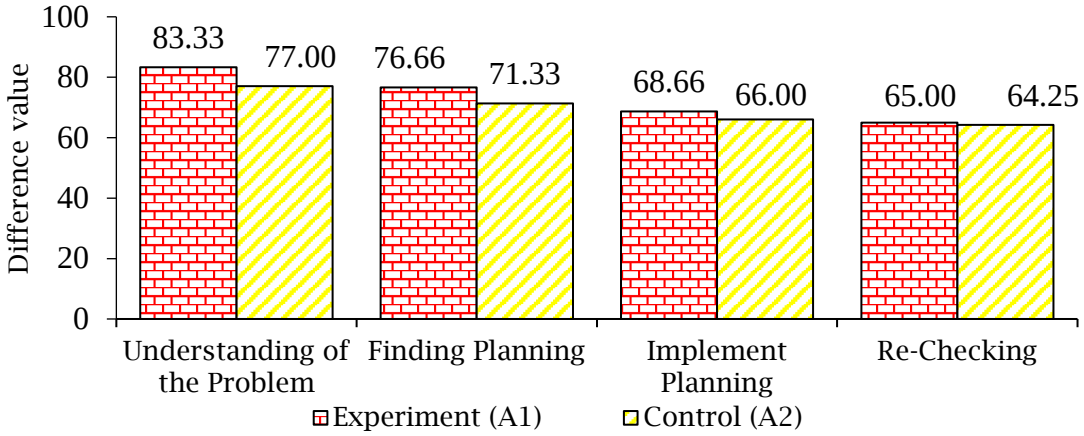


Figure 1. The difference in the value of the problem-solving ability per indicator

Based on the value of the problem-solving ability, the indicator shows that students who learn using the PBL model get a better average score than the control class (Table 3). The difference in the average value of the indicator between the PBL and control classes was 3.76 (Figure 1), with the highest average value found in the problem understanding indicator, while the lowest average value was on the indicator of re-checking. In the indicator of understanding the problem, students only understand and mention the problem in discourse, while in the indicator of checking back students are required to be able to evaluate in detail the problem-solving process. Re-checking requires more ability to find alternative solutions and evaluate the answers that have been obtained (Nurrakhmi & Lukito, 2014).

The results of hypothesis testing indicate that the PBL model has a positive impact on students' problem-solving abilities in the human reproductive system. This is proven from the significant value < 0.05, meaning that there is an effect of the PBL model on the problem-solving ability of the human reproductive system. The series of PBL learning activities has a positive impact on the results of students' problem-solving scores. This is predicted to be one of the factors resulting in a higher PBL class average score than the control class. The more students are often trained and accustomed to solving problems in learning using the PBL model, the better the students' ability to apply the concept of solving problems (Wahyu et al., 2017).

Value of problem-solving ability in students with high intrapersonal intelligence (B1) and low intrapersonal intelligence (B2)

The mean score of the group of students who had high intrapersonal intelligence (B1) was higher than that of the group of students who had low intrapersonal intelligence (B2). The difference in the mean score of the problem-solving ability of a group of students who have high intrapersonal intelligence (B1) and low intrapersonal intelligence (B2) is 5.67 (Table 4).

Table 4. Statistical data on the ability to solve indicator problems based on high intrapersonal intelligence (B1) and low intrapersonal intelligence (B2)

Information	Intrapersonal intelligence	
	High (B1)	Low (B2)
Mean	74.83	69.16
Mean Max	85.33	79.00
Mean Min	66.00	63.00
Standard deviation	8.494	7.290
Variant	72.15	53.15

The results showed (Figure 2) that groups of students who had high intrapersonal intelligence (B1) obtained different mean scores from students who had low intrapersonal intelligence (B2). The difference in scores obtained between the two groups was 6.95. The score indicated that students who had high intrapersonal intelligence had better problem-solving abilities than students who had low intrapersonal intelligence. Based on the value of the problem-solving ability, the indicator shows that groups of students who have high intrapersonal intelligence get a better difference in value compared to groups of students who have low intrapersonal intelligence.

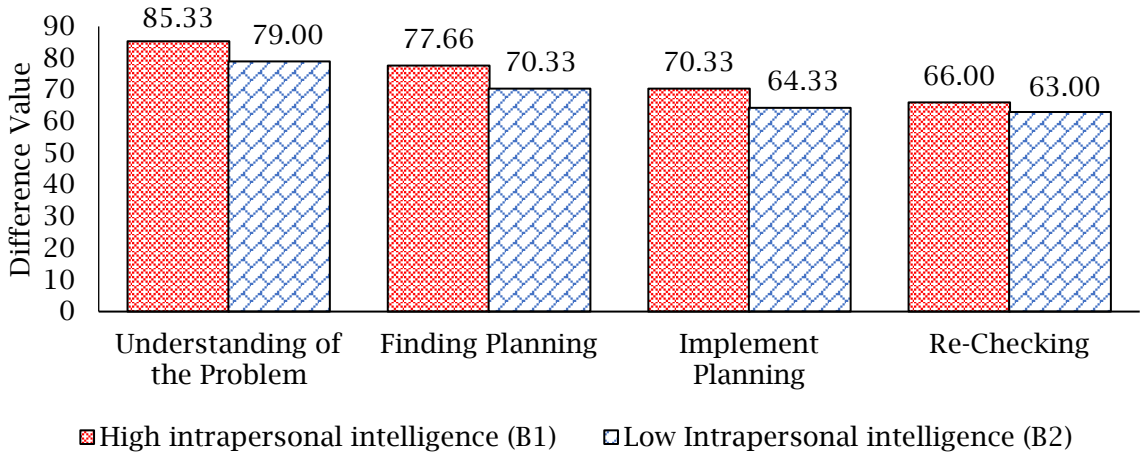


Figure 2. Difference in the value of problem-solving abilities based on intrapersonal intelligence

According to Armstrong (2018), intrapersonal intelligence is defined as the ability to understand oneself and act on that understanding. This intelligence includes the ability to understand self accurately, awareness of moods, intentions, motivation, temperament, and desires, as well as the ability to self-discipline, understand and respect oneself. In general, intrapersonal intelligence can be explained as an ability related to awareness and knowledge of oneself. Students are able to understand their own strengths and weaknesses, are able to motivate themselves and exercise self-discipline. Students who have high intrapersonal intelligence will be able to motivate themselves by using their strengths in solving problems.

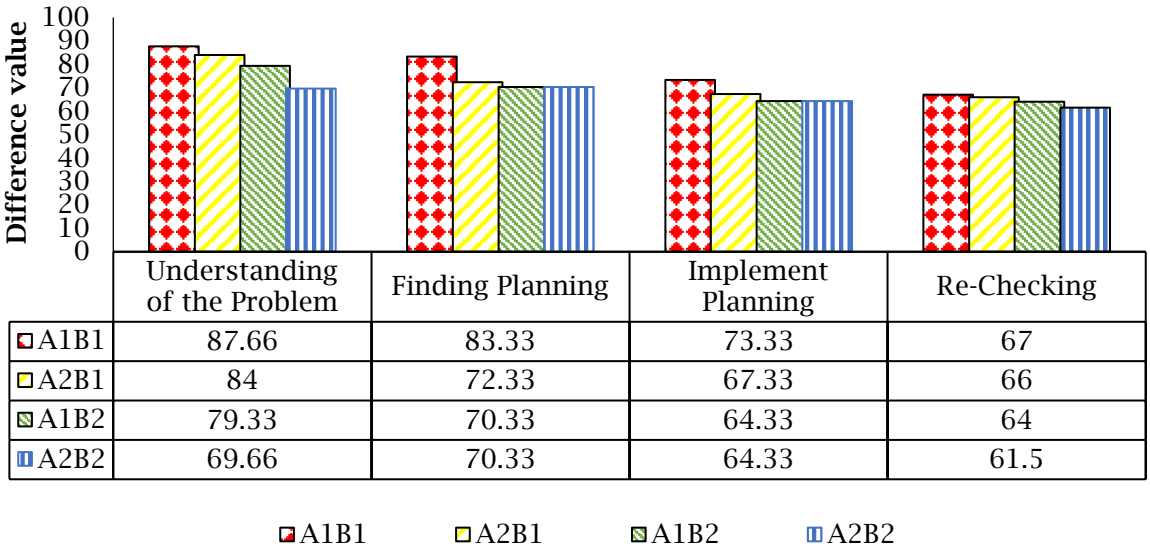
According to Sigit et al., (2017) that there are several other factors that influence the ability to solve problems: the skills of teachers, students, the learning atmosphere, and the school environment. This statement can be interpreted that if it is related to intrapersonal intelligence, intrapersonal intelligence can be classified as student factors. Developing problem-solving skills can be done by understanding the emotions, strengths, weaknesses, goals and things that are important. Assessment of intrapersonal intelligence is something new for students. Sometimes students who have intrapersonal intelligence are more comfortable doing things on their own, while solving problems requires interaction to obtain information as a form of solution. Students who have high intrapersonal intelligence in solving problems have characteristics: working alone, thinking independently in understanding problems, finding plans, implementing, plans and assessing the results of problem solving. This is in line with Armstrong (2018) opinion that Individuals with high intrapersonal intelligence have viable and practical concepts of self.

Value of problem-solving ability per indicator in groups A1B1, A2B1, A1B2, and A2B2

Based on the scores of the ability to solve problems per indicator (Table 5), it is known that the acquisition of the highest average value is found in the group of students who study with the PBL model who have high intrapersonal intelligence (A1B1) with a value of 77.83 while the lowest average value is found in the group of students who learn using the PBL model who have low intrapersonal intelligence A2B2 with a score of 66.45.

Table 5. Statistical data on the problem-solving ability of indicators in groups A1B1, A2B1, A1B2, A2B2

Information	A1B1	A2B1	A1B2	A2B2
Mean	77.83	72.41	69.49	66.45
Mean Max	87.66	84.00	79.33	70.33
Mean Min	67.00	66.00	64.00	61.50
Standard deviation	9.388	8.19	7.171	4.256
Variant	88.13	67.07	51.43	18.11



	Understanding of the Problem	Finding Planning	Implement Planning	Re-Checking
A1B1	87.66	83.33	73.33	67
A2B1	84	72.33	67.33	66
A1B2	79.33	70.33	64.33	64
A2B2	69.66	70.33	64.33	61.5

Figure 3. The difference in the value of the problem-solving ability indicator

Based on the difference in each group A1B1, A2B1, A1B2, and A2B2 that there are differences in the acquisition of problem-solving scores in each group (Figure 3). On the other hand, it can be interpreted that the PBL model and have intrapersonal intelligence (A1B1) are better than the group of students who learn with the PBL model and have low intrapersonal intelligence (A1B2). The group of students who studied with the PBL model and high intrapersonal intelligence (A1B1) obtained better average scores than the group of students who studied with the STAD model and had high intrapersonal intelligence (A2B1). The average score for the group of students who study with the PBL model and have low intrapersonal intelligence (A1B2) is better than the group of students who learn with STAD and have intrapersonal intelligence (A2B2). This happens due to several factors in the learning process using PBL. Students in PBL learning need high-order thinking skills because students must analyze various information obtained to find the right solution (Nabilah et al., 2019).

Based on the results of the two-way ANAVA test, it was found that the value of Sig > 0.05. This result indicates that there is no interaction between the model and intrapersonal intelligence on students' problem-solving abilities. In this study, it means that the PBL variables and students intrapersonal intelligence have no interaction in influencing the problem-solving ability but these variables stand on their own in influencing the results of students' problem-solving abilities. According to Sellars (2006), the student has high intrapersonal intelligence are who can prepare aspect of knowledge and skill needed to develop self-directed learning. This proves that students who have high intrapersonal intelligence tend to be anti-social and dependent. This means that students who have high intelligence prefer to do things independently, without being tied to other people. Students who have high intrapersonal intelligence prefer to study alone than in groups.

In solving problems, students who have high intrapersonal intelligence always interrogate themselves by understanding their strengths which can be used to solve problems without needing help from others. Students are more confident in their abilities and think positively about the success they have achieved. Achievement solves problems purely from the result of one's own thinking patterns without the help of others. Students are much more likely to participate in anti-social behaviors. Intrapersonal intelligence is the perception of one's own strengths, weaknesses, and emotional intelligence. This intelligence is predicted to be the more dominant intelligence to do things independently and not to depend on others, so it is predicted that this is the cause of the absence of interaction between intrapersonal intelligence and the PBL model. Students who have intrapersonal intelligence are able to understand and control their own condition (Kelly, 2015).

Table 6. The result of the calculation of the normality test

Groups	A1B1	A1B2	A2B1	A2B2
N	18	18	18	18
Mean	78.55	70.38	73.38	67.66
Kolmogorov-Smirnov	0.736	0.571	0.497	0.318
Asymp.Sig. (2-tailed)	0.652	0.901	0.966	1.00
Information	Normal	Normal	Normal	Normal

Prerequisite Test

Before testing the hypothesis, a pre-requisite test is conducted to determine the normality and homogeneity of the data. The data normality test was carried out by the Kolmogorov-Smirnov test using the SPSS 21.0 program. The normality test aims to determine whether the distribution of each variable is normal or not. The results of the data normality test can be seen in Table 6.

Table 6 shows that AIBI, A1B2, A2B1, A2B2 groups, each of which totaled 18 students, all have Asymp. Sig. (2-tailed) > 0.05. It means that the data is normally distributed

The homogeneity test was carried out with the Levene's test using the SPSS 21.0 program. The homogeneity test was carried out to determine whether the two classes being tested: experimental class and the control class, had the same variance or not. The results of the homogeneity test can be seen in Table 7.

Table 7. The results of the group variant homogeneity test with the Levene's test

Groups	Sig.	Information
A1B1, A1B2, A2B1, A2B2	0.757	Homogeny

Based on Table 7, it can be seen that the results of the homogeneity test of the data for groups A1B1, A1B2, A2B1, A2B2 have a sig value greater than 0.05. This shows that the distribution of research data is homogeneous.

Hypothesis testing

The significance of the influence of the PBL model and intrapersonal intelligence on students' problem-solving abilities in the reproductive system material in the experimental class and the control class can be determined by testing the 2-way ANAVA hypothesis. The results of hypothesis testing can be seen in Table 8.

Based on Table 8, the ANAVA calculation results in the data model group show the value of Sig 0.026 < 0.05. It shows that there is an effect of the PBL model on students' problem-solving abilities. The results of ANAVA calculations in the intrapersonal intelligence data group on students' problem-solving abilities obtained a sig 0.00 < 0.05. This shows that there is an influence on the level of intrapersonal intelligence on students' problem-solving abilities. Based on the results of the ANAVA calculation, the interaction data group of learning models and intrapersonal intelligence obtained a sig 0.483 > 0.05 so that the data proves that there is no interaction between learning models and intrapersonal intelligence on students' problem-solving abilities.

The significant effect of the PBL model and intrapersonal intelligence on students' problem-solving abilities is the presentation of the problems presented in the LKS. This makes students work together to solve problems, so that students get used to practicing problem-solving skills. This statement is in line with the opinion of Zakia et al., (2019) that student learning outcomes in PBL learning are because students are given worksheets containing problems from real life. Students actively seek the information they need from various sources. The problems presented by the teacher should trigger students to think using the potential that is in students (Listiani et al., 2017; Ma et al., 2008). The PBL model is one of the factors that causes the problem-solving ability in the experimental class is better than in the control class. This is because there is a link between the PBL learning syntax and the problem-solving ability indicator. PBL syntax is in line with problem solving process indicators (Nabilah et al., 2019).

Second, the ability to solve problems is influenced by several factors including internal factors that exist within students. This factor is intrapersonal intelligence. Students who have high category of intrapersonal intelligence will try to understand themselves, use their strengths, weaknesses, and emotions to find information to solve problems. Intelligence is the ability to solve problems and create student creativity (Chatib & Said, 2012).

Table 8. The result of the 2-way ANOVA hypothesis test

Data source	III Squares sum type	Db	Average square	Sig.
The influence of all variables	1175[a]	3	391.66	0.000
Intersep	3784	1	37845	0.000
Model	280.0	1	280.05	0.026
Intrapersonal intelligence	868.0	1	868.05	0.000
Model*Intrapersonal	26.90	1	26.889	0.483
Error	3671	68	53.985	
Total	3832	72		
Total repair	4846	71		

Third, the PBL model is a problem-based model that orientates students towards solving problems together. This means that the PBL model cannot present a problem by reviewing intrapersonal intelligence. In learning PBL there needs to be student interaction with students or students and teachers to discuss each other about solving problems through understanding problems together, planning problem solving plans together, implementing planning and checking the truth of problem-solving solutions, while students who have intelligence intrapersonal prefer to solve problems independently. Students who have intrapersonal intelligence, among others, tend to like solitude, reflect, and have dialogue with themselves (Uno & Kuadrat, 2009).

Conclusion

Problem-based learning can impact students' ability to solve problems in learning the human reproductive system; in addition to problem-solving abilities, it is also supported by high intrapersonal intelligence. However, there was no significant interaction between problem-based learning and intrapersonal intelligence on problem-solving abilities.

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