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THE EFFECT OF PROBLEM BASED LEARNING MODEL ON STUDENTS' SELF-CONCEPT AND METACOGNITIVE ABILITY ON EXCRETION SYSTEM

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ABSTRACT

Science education aims to enable teachers to teach problem-solving in the teaching and learning process. Students should have at least two competencies to achieve learning objectives, including metacognitive abilities and the ability to recognize their potential, interests, talents. The ability to recognize potential, interests, and talents are related to self-concept. One alternative learning model that can develop a positive self-concept and train students' metacognitive abilities is the problem-based learning model. The learning process on the excretory system material demands a process of discovery and problem solving that trains students' metacognitive abilities. This study aims to determine the effect of the Problem Based Learning model on students' self-concept and metacognitive abilities. The research sample was two classes obtained based on the purposive sampling technique. The research design used is the Pretest-Postest Nonequivalent Control Group Design. The research data was obtained from self-concept questionnaires and students' metacognitive abilities. The results showed that the average value of self-concept and metacognitive abilities of students taught using the PBL model was more significant than the class taught using the DL model. The results of hypothesis testing and effect size also show that the PBL model significantly affects students' self-concept and metacognitive abilities with scores of 1.9 (high) and 2.4 (high).

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INTRODUCTION

Science education aims to enable teachers to teach problem-solving in the teaching and learning process. The problem-solving process requires students to master five aspects of ability: the ability to understand science concepts, the ability to master science skills, the ability to understand science, the ability to have a positive attitude towards science, and metacognitive abilities (Iskandar, 2014).

One of the core competencies in the 2013 curriculum, core competency number 3 class XI SMA states that students must understand, apply, and explain factual, conceptual, procedural, and metacognitive knowledge in science, technology, art, culture, and humanities with human insight. Nationality, state, and civilization are related to the causes of phenomena and events. Students must also apply procedural knowledge in specific fields of study according to their talents and interests to solve problems (Kemendikbud, 2013). Based on the description above, it can be concluded that students should have at least two competencies to achieve learning objectives. These competencies include metacognitive abilities and recognizing their potential, interests, talents. The ability to recognize potential, interests, and talents are related to self-concept.

Self-concept has an important role in students' academic engagement, goal setting, persistence and effort, intrinsic motivation, strategy use, performance, and achievement (Sobur, 2003). If students have a negative self-concept, various problems will arise, such as unrealistic expectations, low self-esteem, feeling that they have no potential, low learning motivation, easily discouraged, and lack of confidence, which ultimately impact learning outcomes.

In addition to self-concept, students should have other abilities to achieve learning goals are metacognitive abilities. It is in line with Livingston's (1997) opinion that metacognition plays a critical role that is very important for successful learning. Metacognitive relates to a person's ability to monitor or regulate, evaluate his cognitive activity in problem-solving (Flavell et al., 2002).

Based on the results of direct interviews with class XI biology teachers, it can be seen that the school has implemented the 2013 curriculum. Teachers still use teacher-centered learning methods, including lectures, discussions, assignments, field learning, and practicum. Based on the observations, some students tend only to pay attention to the teacher's explanation, and only a few students ask questions. It shows that the learning method can affect students' learning motivation which causes students to be less active in learning.

Another problem known from the interviews' results is that when the teacher assigns students to work on practice questions or exams, some students cheat or act fraudulently. One of the factors causing this problem is a negative perception of their abilities so that students feel less confident to do exams or assignments independently. The facts found in the field indicate that student activities related to positive self-concepts and metacognitive abilities have not been trained in the learning process.

One alternative learning model that can develop a positive self-concept and train students' metacognitive abilities is the Problem Based Learning (PBL) learning model. The PBL model is a problem-oriented model in the learning process that integrates knowledge, critical thinking, collaboration, and creates a strong motivational effect. Activities in PBL also clearly involve metacognitive processes, namely problem orientation, problem analysis, group investigations, presenting work, and evaluating problem solving processes. This is in line with the research of Sihombing et al. (2018) which states that the PBL model with mind mapping techniques influences students' critical thinking skills and metacognitive knowledge which can improve students' understanding of biological concepts. The results of research conducted by Fitriyani et al. (2015) also showed that the PBL learning strategy influenced students' metacognitive skills, critical thinking, and cognitive learning outcomes on cell material, plant and animal tissues.

The excretory system studies various problems related to students' self, such as the working process of the excretory organs in humans and abnormalities in the excretory system. The learning material cannot be directly observed in the work process and cannot be explained simply by taking notes, lecturing, or discussing. The learning process on the excretory system material demands a process of discovery and problem solving that trains students' metacognitive abilities.

One example of a problem in the sub-material of disorders of the excretory system related to students is the problem in the excretion of sweat on the skin, which triggers the appearance of acne. Excretory system material also discusses the excretory system in the kidneys, lungs, and liver which is also related to students' daily lives. The application of the PBL model associated with students is expected to develop positive self-concepts and metacognitive abilities

to find their understanding according to the concept of the excretory system.

Based on the problems described above, it is necessary to research the effect of problem-based learning models on self-concept and students' metacognitive abilities on excretory system material. This study aims to determine the effect of the problem-based learning model on students' self-concept and metacognitive abilities.

METHOD

The type of research in this study is quasi-experimental. The research population was all students of class XI MIA MAN 2 Deli Serdang, which consisted of 3 classes with 104 students. Sampling was done using the purposive sampling technique and obtained research samples with similar pretest scores, namely class XI MIA 3 (experimental class) and XI MIA 1 (control class). The experimental class was treated using a problem-based learning model, and the control class using a direct learning model. This study's independent variable (X) is the problem-based learning model. At the same time, the dependent variable (Y) is self-concept and students' metacognitive abilities. This study used a pretest-posttest nonequivalent control group design.

The research instrument consisted of learning instruments and data collection instruments. Learning instruments include Learning Implementation Plans (RPP) and student worksheets (LKPD). Data collection instruments include a self-concept questionnaire adapted from Liu & Wang (2005) on the academic self-concept questionnaire (ASCQ) and a metacognitive ability questionnaire adapted from Schraw and Dennison (1994) on Metacognitive Awareness Inventory (MAI). The data obtained in this study is a type of quantitative data derived from self-concept questionnaires and students' metacognitive abilities before (pretest) and after (posttest) the learning process.

The data analysis technique used descriptive statistical analysis and inferential statistical analysis. Descriptive statistical analysis is to describes the results of student questionnaires into categories. Inferential statistical analysis tests the hypothesis using the t-test (paired sample t-test) with a significance level of 0.05. Before testing the hypothesis, a prerequisite test was first carried out. Then N-gain test was carried out to provide an overview of the increase in results between before and after learning. Furthermore, according to Cohen, measuring the magnitude of the effect or influence of a variable on other variables using the effect size test.

RESULTS AND DISCUSSION

The Effect of PBL Model on Students' Self-Concept

The average value of the self-concept pretest of students in the control class is 65.89 with a standard deviation of 3.87, while in the experimental class, it is 66.76 with a standard deviation of 3.17. After applying the problem-based learning model, the average post-test value in the control class is 75.00 with a standard deviation of 5.95, while the post-test average value in the experimental class is 79.36 with a standard deviation of 7.46. These results indicate that both classes experienced an increase in the average value of self-concept. The experimental class that applied PBL experienced an increase of 38% (medium), while the control class experienced an increase of 27% (low). The results of hypothesis testing using paired t-test are show in table 1.

Table 1 shows a significance value of 0.000 < 0.05 in the experimental class and 0.009 < 0.05 in the control class. Both classes influence students' self-concept, but the increase in the average value of the experimental class taught using problem-based learning is higher than the control class. The effect size test results show that problem-based learning affects self-concept and is included in the high category with a value of 1.9. (Cohen et al., 2011). Thus, it can be concluded that Ha is accepted. There is an effect of the problem-based learning model on students' self-concepts.

Table 1. The results of the self-concept hypothesis test after learning activities

Class	Average		*Sig*	α	Description
	Pre-test	*Post-test*			
Problem based learning	66,76	79,36	0,000	0,05	There is a significant difference between the pretest and posttest scores
Direct learning	65,89	75,00	0,009		There is a significant difference between the pretest and posttest scores

The increase in the average self-concept, which is better in the PBL class than the DL class, cannot be separated from the characteristics of the PBL model itself. The problem-solving concept seen in the PBL syntax directs students to be responsible for the learning they are going through and not too dependent on the teacher.

During the learning process, PBL class students tend to be more enthusiastic about participating in the learning process because they must explore their knowledge in problem-solving. The results obtained are also supported by Wulandari's (2013) opinion that students taught using the PBL model are more motivated to explore knowledge to solve problems related to the real world. In line with Madiya's research (2012), the PBL learning model can provide better student achievement and self-concept scores than the EEK learning model. The post-test aspect of self-concept also showed better results in the PBL class than the DL class.

The percentage achievement of knowledge aspects in the experimental class is 81.65, and the control class is 76.93. Based on these percentages, it can be concluded that students in the experimental class have a better perception of physical and academic achievement than the control class. The difference is because the PBL model emphasizes collaborative learning between students. When students discuss and work together, they will be able to see a picture of themselves and their academic achievements.

The percentage of achievement of expectation in the experimental class is 80.39, and the control class is 75.78. It means that students taught with PBL have better motivation and self-confidence than in the DL class. The PBL model empowers the process of problem-solving and collaboration in learning that can trigger enthusiasm and motivation to explore knowledge to solve problems. Similar research conducted by Isroila et al. (2018) shows that the problem-based learning model can help students become more independent and believe in their intellectual skills. While in the DL class, the learning process tends to be teacher-centered so that it does not provide opportunities for students to work independently.

The percentage achievement of the assessment aspect in the experimental class is 73.99, and the control class is 70.10. It means that the ability of students to know their existence in a group and see themselves positively in the PBL class is better than the DL class. The results of Jaya et al. (2019)'s research shows that the PBL model makes students more aware of their existence through actively proposing ideas in group discussions. In the learning process in the experimental class, students are more active and enthusiastic in group discussions than in the control class.

Differences in the self-concept of control class students with practical classes based on self-concept can be seen in Figure 1. Figure 1 shows that the highest percentage of self-concept achievement in the experimental and control classes lies in the knowledge aspect, 76.93%, and 81.65%, respectively.

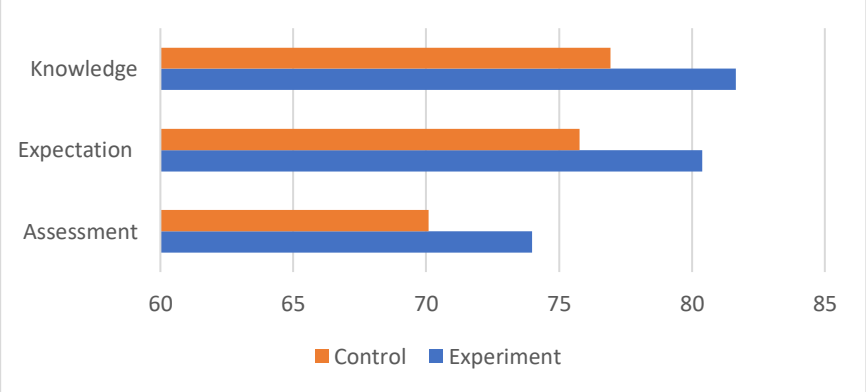

Figure 1. Graph of differences in students' self-concepts based on aspects of self-concept

The Effect of PBL Model on Students' Metacognitive Ability

The mean value of the pretest metacognitive ability of students in the control class is 63.25 with a standard deviation of 3.77, while the average

value of the pretest in the experimental class is 63.63 with a standard deviation of 5.01. As for after the learning activities were carried out, the average posttest score in the control class was 74.44 with a standard deviation of 6.21, while the posttest average value in the experimental class was 82.17 with a standard deviation of 8.82. These results indicate that both the experimental and control classes experienced an increase in the average value of metacognitive abilities. The experimental class that applied problem-based learning experienced an increase of 51% (medium), while the control class that applied direct learning experienced an increase of 30% (low). Subsequently, the hypothesis was tested using a paired t-test, and the following results were obtained.

Table 2. Hypothesis test results of metacognitive ability after learning activities

Class	Average		*Sig*	α	Description
	Pre-test	***Post-test***			
Problem based learning	63,63	82,17	0,000	0,05	There is a significant difference between the pretest and posttest scores
Direct learning	63,25	74,44	0,000		There is a significant difference between the pretest and posttest scores

Table 2 shows a significance value of 0.000 < 0.05 in the experimental class and 0.000 < 0.05 in the control class. So, it can be stated that both classes influence students' metacognitive abilities. The average value in the experimental class was higher than in the control class. The result of the effect size test also shows that the effect of problem-based learning on students' metacognitive abilities is included in the high category with a score of 2.4. (Cohen et al., 2011). Thus, it can be concluded that Ha is accepted. There is an effect of the problem-based learning model on students' metacognitive abilities.

The research results obtained are also supported by the results of Fitriyani et al.'s (2015) research, which states that the PBL model significantly affects students' metacognitive skills. The results of a similar study were carried out by Sihombing et al. (2018), which stated that the problem-based learning model with mind mapping techniques could familiarize students with critical thinking skills and improve understanding of Biology concepts as well as increase students' metacognitive knowledge and awareness.

Learning by practicing problem-solving skills is closely related to students' metacognitive abilities. The originator of the term metacognitive, Flavell et al. (2002), stated that metacognitive ability refers to a person's ability to monitor or regulate, evaluate his cognitive activities that are seen during the problem-solving process. PBL can also positively affect students' learning processes, such as developing self-directed, critical thinking skills, practicing collaborative learning, and creating a solid motivational effect (Bahri, 2016).

The results of the posttest in terms of metacognitive dimensions showed that the percentage of students' metacognitive ability achievement was better in the experimental class than in the control class. The percentage of achievement of planning dimensions in the experimental class is 81.79 (very well developed) and 74.86 control class (already developed). The percentage results indicate that students who are taught using PBL can realize the thinking process and describe it. The PBL model encourages students to solve a problem to increase planning skills actively. Celiker (2015) states that students use their metacognitive awareness in the problem-solving process by making students active in solving problems, finding concepts, and evaluating problems.

The percentage results of the achievement of the information management strategy dimension in the experimental class are 82.90 (very well developed) and 75.60 control class (already developed). It shows that students who are taught using PBL have been able to develop an introduction to thinking strategies, think about the goals that have been set, and detailed information from various sources. The PBL model requires students to participate in the learning process using strategies such as identifying problems in the discourse to understand information. Thus, students who are taught to use PBL can improve their ability to manage information strategies.

The percentage of achievement of the monitoring dimension on understanding in the experimental class is 81.85 (very well developed) and 73.06 control class (already developed). Students taught with PBL can check their learning progress and assess the use of strategies. The stage of developing and presenting work in PBL syntax can develop students' metacognition, namely monitoring how well students do assignments. Jacobsen et al. (2009) stated that the presentation stage in learning is crucial because it involves a high level of student participation to

develop a relatively deep understanding of the material.

The percentage of achievement of the improvement strategy dimensions in the experimental class is 83.06 (very well developed) and 76.83 control class (already developed). Students taught using the PBL model can monitor, assess, and design strategies to increase understanding and correct previous mistakes. The stage of analyzing and evaluating the problem-solving process in the PBL model encourages students to reconstruct their thoughts and reflect on their activities during the learning process. These activities can develop students' metacognitive abilities, namely improvement and evaluation strategies.

The results of calculating the metacognitive dimension of the evaluation of the average score in the experimental class are 82.33 (very well developed) and 73.54 control class (already developed). On average, students who are taught using PBL can already analyze the extent of the truth about their knowledge and the effectiveness of problem-solving strategies.

The difference between the metacognitive abilities of the control class students and the experimental class based on the metacognitive dimensions can be seen in Figure 2.

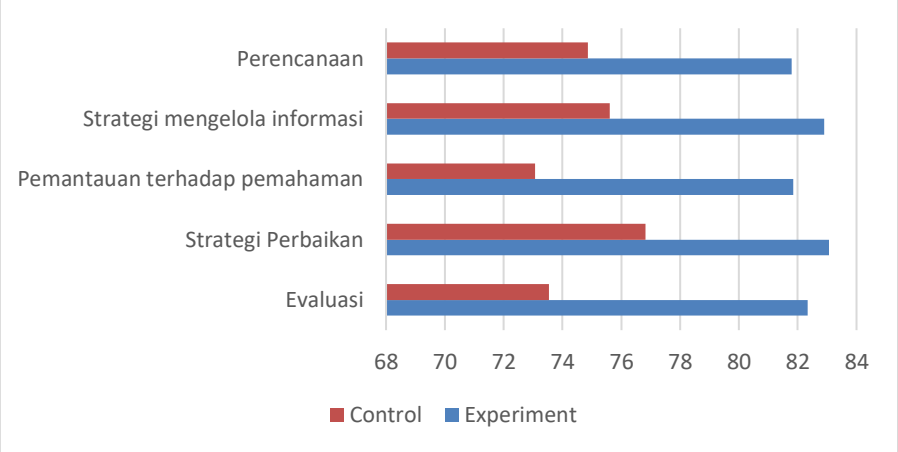

Figure 2. Graph of differences in students' metacognitive abilities based on metacognitive dimensions

Figure 2 shows that the percentage of achievement of the highest metacognitive ability dimension in control and experimental classes lies in the improvement strategy dimension, 76.83%, and 83.06%, respectively.

The higher self-concept gain value and metacognitive ability in the experimental class and control class cannot be separated from the advantages in PBL learning. The syntax contained in the PBL learning model can positively affect self-concept, especially intrinsic motivation, self-confidence, and ability in the discussion, as well as students' metacognitive abilities, which include planning, monitoring, and evaluation. Sutirman (2013) also states that the problem-based learning model has several advantages, namely (1) Improving student learning activities; (2) Helping students transfer their knowledge in understanding real-life problems; (3) Developing new knowledge and being responsible for its learning; (4) Providing students with an understanding that learning is a thinking process, not just acquiring knowledge from the teacher; (5) Develop students' interest in learning for life.

CONCLUSION

Based on the results and discussion of the research that has been carried out, it can be concluded that the Problem Based Learning model has a significant effect on students' self-concept on the excretory system material in class XI MIA MAN 2 Deli Serdang for the 2019-2020 school year with an effect size value of 1.9 (high).

The Problem Based Learning model significantly affects students' metacognitive abilities on excretory system material in class XI MIA MAN 2 Deli Serdang for the 2019-2020 school year with an effect size value of 2.4 (high).

REFERENCES

Bahri, A. (2016). *Pengaruh Strategi Problem Based Learning (PBL) Terintegrasi Reading, Questioning, And Answering (RQA) Pada Perkuliahan Biologi Dasar Terhadap Motivasi Belajar, Keterampilan Metakognitif, Hasil Belajar Kognitif, Retensi, dan Karakter Mahasiswa Berkemampuan Akademik Berbeda*.

(Disertasi Doktoral, Universitas Negeri Malang)

Celiker, H. D. (2015). Development Of Metacognitive Skills: Designing Problem Based Experiment with Prospective Science Teachers in Biology Laboratory. *Academic Journal*. 10(11): 147-1495.

Cohen, L., Manion, L., Morrison, K. (2011). *Research Methods in Education (7th ed.)*. London: Routllege Falmer.

Flavell, J. H., Miller, P. H., & Miller, S. A. (2002). *Cognitive Development (4th ed.)*. Upper Saddle River, NJ: Prentice Hall.

Fitriyani, R., Corebima, A. D., Ibrohim. (2015). Pengaruh Strategi Pembelajaran *Problem Based Learning* dan Inkuiri Terbimbing Terhadap Keterampilan Metakognitif, Berpikir Kritis, dan Hasil Belajar Kognitif Siswa SMA. Jurnal Pendidikan Sains. 3 (5): 186-200.

Iskandar S, M. (2014). Pendekatan Keterampilan Metakognitif dalam Pembelajaran Sains di Kelas.*Erudio*. 2 (2): 13-20.

Isroila, A., dkk. (2018). Pengaruh Self Confidence Terhadap Pemahaman Konsep Siswa Melalui Penerapan Model Problem Based Learning. *Natural Science Education Research*. 1 (1): 1-8.

Jacobsen, D., Eggen, P., Kauchak, D. (2009). *Methods for Teaching Edisi ke-8*. Yogyakarta: Pustaka Pelajar.

Jaya, A., Waluyo, S. B., Siswanto, B. (2019). Implementasi Model *Problem Based Learning* untuk Meningkatkan Kemampuan Komunikasi Matematis dan Percaya Diri Siswa Kelas X Sma Negeri 4 Semarang. *PRISMA*. 2: 410-415.

Kemendikbud. (2013). *Kerangka Dasar Kurikulum 2013*. Jakarta: Kementerian Pendidikan dan Kebudayaan Direktorat Jenderal Pendidikan Dasar.

Liu, W. C. & Wang, C. K. J. (2005). Academic self-concept: A cross-sectional study of grade and gender differences in a Singapore Secondary School. *Asia Pacific Education Review*. 6(1): 20-27.

Livingston, J. A. 1997. *Metacognition: An Overview*. http://www.gse.bufallo.edu/fas/shuell/cep564/metacog.htm, (Diakses pada 22 November 2018).

Madiya, I. W. (2012). Pengaruh Model Pembelajaran Berbasis Masalah Terhadap Prestasi Belajar Kimia Dan Konsep Diri Siswa Sma Ditinjau Dari Gaya Kognitif. *Jurnal Pendidikan dan Pembelajaran IPA Indonesia*. 2 (2): 1-15.

Schraw, G. & Dennison, R.S. (1994). Assessing metacognitive awareness. *Contemporary Educational Psychology.*19: 460-475.

Sihombing, C., Hutauruk, D.K., Efendi, (2018). Pengaruh *Model Problem Basic Learning* Dengan *Teknik Mind Mapping* Terhadap Kemampuan Berpikir Kritis dan Pengetahuan Metakogitif Siswa Sekolah Menengah Pertama.*Jurnal Pendidikan Biologi*. 8 (1): 1-5.

Sobur, A. (2003). *Psikologi Umum*. Bandung: Pustaka Setia.

Sutirman. (2013). *Media & Model-Model Pembelajaran Inovatif*. Yogyakarta: Graha Ilmu.

Wulandari, B. (2013). Pengaruh Problem-Based LearningTerhadap Hasil BelajarDitinjau Dari Motivasi Belajar PLC Di SMK. *Jurnal Pendidikan Vokasi*. 3 (2): 178-191.