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Problem-based Learning: Improving Students' Concept Mastery and Learning Activities

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Abstract. The purpose of the study was to determine the effect of problem-based learning on the concept mastery and learning activities of students. The research method used is a quasi-experimental research design with a non-equivalent pretest-posttest control group. The sample had selected through purposive random sampling. The instrument used is a conceptual understanding test instrument with an indicator of adaptation knowledge dimensions from Bloom's taxonomy and a learning activity instrument of a questionnaire. In the results of this study, there are differences between the experimental class and the control class on understanding concepts and learning activities of students; the PBL model increase students' concept mastery.

Keywords: PBL, concept mastery, learning activity

INTRODUCTION:

Based on the 21st century national education paradigm, several competencies and skills have to possessed students/human resources, namely: (1) critical thinking and problem-solving skills, able to think critically, lateral, and systemic, especially in the context of problem-solving (2) the ability to communicate and cooperate (communication and collaboration skills), able to communicate and collaborate effectively with various parties (3) the ability to create and renew (creativity and innovation skills), capable of developing its creativity to produce various innovative breakthroughs (4) information and communication technology literacy can utilize information and communication technology to improve performance and daily activities (5) contextual learning skills can undergo contextual independent learning activities as part of personal development (6) information and media literacy skills can understand and use various communication media to convey various ideas and carry out collaborative activities and interactions with various parties (Erkoc & Kert, 2013; Hsieh et al., 2013; Ulger, 2016; Wan & Lee, 2017). These abilities need to be based on a good concept masterys so that students can analyze and evaluate the results of their critical and creative thinking in problem-solving.

Competencies and skills have to be possessed by students in the 21st century human resources are by improving the quality of learning, including raising the teaching system and improving the quality of teacher abilities (Perdana et al., 2020). Many things did achieve these goals, such as creating an active,

innovative, creative, and fun learning atmosphere for students for they passionate and fully developed during the learning process (Murnawianto et al., 2019; Nazarieh, 2016; Santi et al., 2019). This COVID-19 pandemic situation requires the creativity and innovation of teachers in designing learning services (Ahied et al., 2020; Juanda et al., 2021; Nursetiawati et al., 2020; Yustina et al., 2020). Distance education encourages students to actively studying independently and able to concept masterys with developing good thinking skills (Ahied et al., 2020; Fikriyah et al., 2020).

Concept mastery is one of the indicators of success for the student that has achieved in science learning (Pujani et al., 2018; Susilaningsih et al., 2019; Tyas et al., 2020). Concept mastery could interpret as the ability of students to understand the meaning scientifically, both concepts in theory and their application in everyday life (Made, 2015). Following this, Winkel (1991) defines concept mastery as an understanding by using drafts, rules, and principles. Students' concept mastery influence by psychological factors (internal), namely intelligence, attention, interest, talent, motivation, maturity, and exhaustion. The ability of concept mastery could have seen from the learning outcomes of students (Rubini et al., 2020; Susbiyanto et al., 2019).

The weak concept masterys is one of the problems in the science learning at SMP Widya Wacana 1 Surakarta that has implications for low student learning outcomes. This condition caused by suspected factors: (1) Students are not optimal in learning (2) The facilities used in teaching and learning activities are still limited (3) the learning strategies applied by teachers do not involve students in learning cooperatively and still dominated by conventional learning, where the teacher still very dominant in the learning process (4) students are still lacking in empowering their abilities in terms of doing higher-order thinking skills during learning (Andini & Hobri, 2017; Pujayanto et al., 2017).

A lesson plan has been conducting to increase student involvement in the science learning process to develop higher-order thinking skills and students' concept mastery (Sholikhan, 2017). Concept mastery could be trained through the steps of the scientific method, which requires students' mental activity to understand a learning concept through situations and problems presented at the beginning of learning to train students to solve problems using a problem-solving approach (Chiang & Lee, 2016; Hidayati & Retnawati, 2016; Uliyandari et al., 2021). Problem-solving has a connection with higher-order thinking skills (Pujayanto et al., 2017). Higher-order thinking skill is a process conducted when bringing a new idea by combining ideas that previously done (Husein et al., 2019; Madyani et al., 2019; Purwati & Murti Prasetyanti, 2019).

The science learning process emphasizes providing hands-on experience to develop competencies to explore and understand the natural surroundings scientifically and made scientifically (scientific inquiry) to foster thinking ability, work and behave scientifically, and communicate it as a crucial aspect of life skills (Prayitno et al., 2017; Zubaidah et al., 2017). To realize science learning has to strengthen students' thinking skills, especially higher-order thinking skills that students' concept mastery might have, and applying concepts on another aspect (Anjarwati et al., 2018). It is schools and teachers duty as the main components of educating, need to manage learning following the principles of teaching and learning activities, including (1) student-centered activities, (2) learning through action, (3) independent learning, and teamwork learning, it isn't only focused on the teacher but how to activate students in their learning (students' active learning) (Ardhian et al., 2020; Fukuyama, 2018; Muhlisin et al., 2016; Susilowati et al., 2018).

The activity of students in science learning is a responsibility and concern of the teacher (Irwanto et al., 2018). Student engagement in learning activities has a positive impact on the achievement of concept mastery has learned them (Arti & Ikhsan, 2020). Therefore, students must be more active by doing something in learning instead of just listening instruction teacher only (Fuad et al., 2017; Kigo et al., 2018; Sasmitatias & Kuswanto, 2018).

Learning activity is an individual activity change for the better person, which there is some interaction between fellow individuals and the individual to the environment (Nisa et al., 2018; Susilowati et al., 2018). According to Techakosit & Srisakuna (2019), learning activities are activities carried out by students during the learning process. Therefore, without any learning activity, the learning process may not take place properly (Djajadi & Rauf, 2020; Usmeldi et al., 2017).

Referring to the problems that describe and implement the curriculum of 2013, one of the learning models that have steps of the scientific method is the PBL model. PBL is a learning model that theoretically could develop various aspects of student competence to improve learning outcomes and learning achievement. An application for this model has not been applied consistently by most teachers at SMP Widya Wacana 1 Surakarta. As for the empirical facts of the success of the PBL model: (1) in PBL, it will be meaningful learning. Students who have learned to solve the problem could apply the knowledge they have or know the knowledge needed. Studying could be valuable and expanded when students are faced with situations that concepts are applied. (2) In PBL, students integrate knowledge and skills simultaneously and apply them in relevant contexts; (3) PBL can improve critical thinking skills, foster student initiative in work, an internal motivation to learn, and has developed interpersonal relationships in group work (Sani, 2014).

PBL is student-centered learning that has beliefs by experts to prepare students to face the world of work in the 21st century (Made, 2015; Kono et al., 2016; Nursa'ban et al., 2019). PBL is effective in building the necessary thinking skills and fostering the expected personal qualities (Andini & Hobri, 2017). The Problem Based Learning (PBL) model is learning has designed for students to gain essential knowledge which makes them proficient in solving problems, has their learning model, and has the skills to participate in teams (Anjarwati et al., 2018; Phaprom et al., 2019; Uliyandari et al., 2021). The learning process uses a systemic approach to solve problems or face challenges as needed in daily life (Nuswowati et al., 2017). This model characterized real-world problems as something that students must learn to practice and improve concept mastery and problem-solving and gain knowledge of essential concepts that teacher duty must focus on helping students achieve self-direction skills (Dewi et al., 2017; Husein et al., 2019).

Following Anwar et al., 2019; Rubini et al., 2020, PBL could improve students' concept masterys and science process skills. The same statement has been stating by Yanto (2016), a result of the study concluded that PBL is superior to conventional learning because PBL can improve students' concept mastery and creative thinking skills.

METHOD

The research data is research and development (R & D). This model is the basis for developing products from the test result of the effectiveness for these products (Sugiyono, 2012). The development in this study was a Problem Based Learning (PBL) science module to improve students' concept mastery and learning activities on substance pressure material and its application in daily life. This study, using a 4-D development model adapted from Thiagarajan et al. (1976). The 4-D includes defining, design, develop, and disseminate. The reasons for choosing the 4-D model in this development with the material pressure of substances and its application in daily life are 1) the development model is simple and understandable so that it is practical to implement; 2) there is a stage of product validation and testing to make the resulting product better; 3) logical development steps. This research was in SMP Widya Wacana 1 Surakarta for a sample of 44 students that were group into experimental and control classes. It has selected by purposive random sampling with the lottery.

The module feasibility test has been validating by validators of material, media, discussion, and learning experts. The effectiveness of the module test using a quasi-experimental research design with the Non-equivalent Pretest-Posttest Control Group has shown in Table 1.

Table 1. Pretest-Posttest Control Group Research Design

Research design	Pretest	Treatment	Posttest
Exp. Class	T_1	X_A	T_2
Ctrl. Class	T_3	X_B	T_4

The instrument used to measure understanding of students' concepts has focused on the knowledge dimension of Bloom's taxonomy (Anderson et al., 2001) and consists of 20 multiple-choice questions. The instrument for student learning activities is a questionnaire that an indicator adapted from Paul B. Diedrich (Sardiman, 2011). Both the instrument validated by expert lecturers (in the content, learning, media, and language) and practicing educators

in natural sciences. In addition, a trial was also conducted for the concept mastery instrument and analyzed for validity, reliability, discriminating power, and level of difficulty. The analysis result shows that the instruments developed are valid and reliable and identify an understanding of student concepts.

The pretest-posttest score of the experimental and control class students differed on the independent sample t-test in which the data declared normal and homogeneous. The decision does if value (sig) < 0.05 reject H_0 and accept H_1, so there is a difference in the value concept mastery in classes that use Problem Based Learning (PBL) modules and classes use books at school (books from publishers). If the value (sig) > 0.05, accept H_0 or reject H_1, there is no difference in the value of concept mastery in classes using Problem Based Learning (PBL) modules and classes using books at school (books from publishers). Increasing the effectiveness of the problem-based learning model in improving the understanding of the experimental and control class concepts is determined through the n-gain test by Hake (1991) with scoring categories in Table 2.

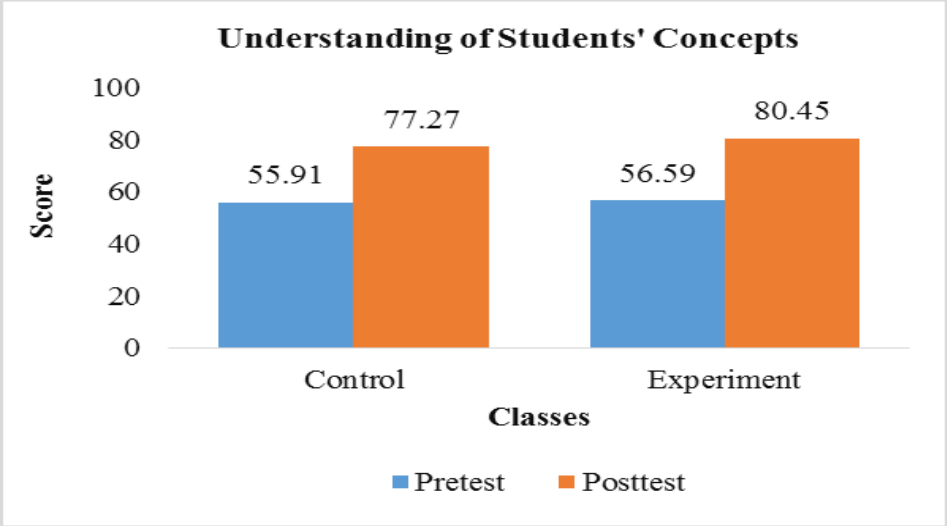
Table 2. N-gain Score

Score <g>	Categories
<g> > 0,7	High
0,7 > <g> > 0,3	Averages
<g> < 0,3	Low

RESULT AND DISCUSSION

Result

Concept Mastery



Graph 1. The Average Score of The Pretest-Posttest Students' Concept Mastery

Table 3. Recapitulation of The Results of The Normality, Homogeneity, and T-Test

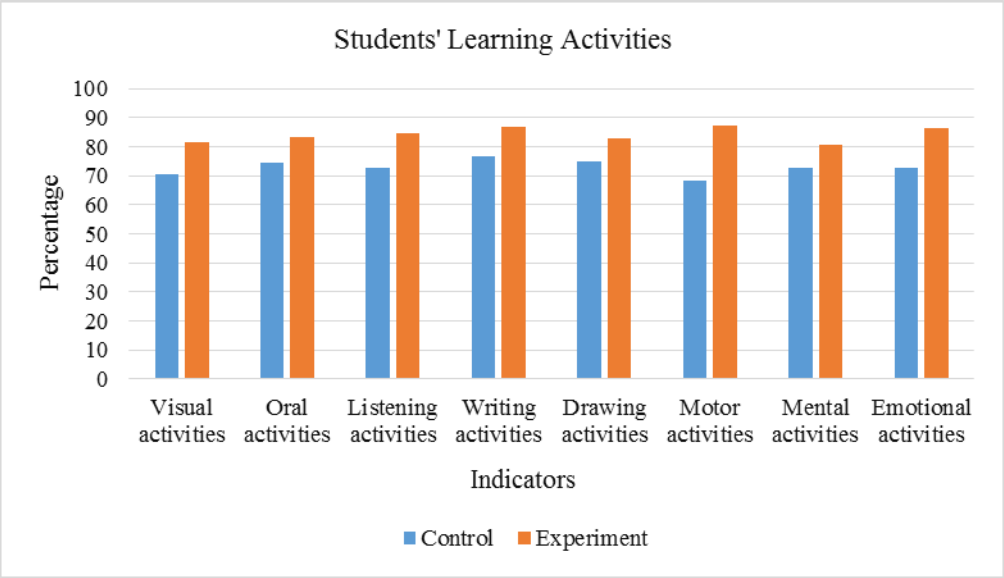
Class	Test	Type of test	Result
Ctrl.	Norm.	Shapiro-Wilk test	Sig. pretest 0.446; Sig. posttest 0. 108
Exp.	Norm.	Shapiro-Wilk test	Sig. pretest 0.301; Sig. posttest 0.197
Pretest	Homog.	Levene's test	Sig. 0.665
Posttest	Homog.	Levene's test	Sig. 0.448
Pretest	T-Test	independent sample t-test	Sig. 0.559
Posttest	T-Test	independent sample t-test	Sig. 0.003

Table 4. N-gain of Students' Concept Mastery

Groups	N-gain	Category
Exp.	0.556	Medium
Ctrl.	0.484	Medium

Learning Activities

Graph 2. The Average Score of Student Learning Activities



Discussion

The application of the appropriate learning model to students affects their activities in class. The active learning of students increases with "the active learning model." The active learning model is a learning that prioritizes student learning activities (Djajadi & Rauf, 2020; Techakosit & Srisakuna, 2019). Student learning activity affects the learning outcomes of students (Arti & Ikhsan, 2020).

This study used the "PBL learning model" to observe the learning outcomes of students. This study used The PBL learning model in the subject matter of "substance pressure in everyday life." The implementation of the research starts from the teacher giving questions; motivate students to be active in searching for answers; guide students to the presentation of learning outcomes; reinforce the concept of subject matter; provide practice questions to students.

The results showed that these variables had a significant effect on increasing understanding of student concepts. These results strengthen by Anwar et al., 2019; Hidayati & Retnawati, 2016; Husein et al., 2019; Kono et al., 2016; Susbiyanto et al., 2019; Uliyandari et al., 2021; Yanto, 2016. The process of the "PBL learning model" uses a scientific approach (Anwar et al., 2019; Made, 2015). The scientific oncoming trains students to be active in learning (Ahied et al., 2020; Hidayati & Retnawati, 2016). The impact of "the PBL learning model" on student learning activities showed in Graph 2.

According to Nursa'ban et al. (2019), The PBL (read-Problem Based Learning) learning model trains students to find solutions independently. The PBL learning model emphasizes creativity and initiative for students in developing knowledge and concepts from the subject matter (Yanto, 2016). The PBL learning model also practices students to think divergently (Anazifa & Djukri, 2017; Grant, 2014; Khoiriyah & Husamah, 2018; Yazar Soyadı, 2015). The PBL learning model practices students to think divergently by reading, asking, experimenting, analyzing, graphing, discussing, and solving problems.

Appropriate learning supports the understanding of the concept of the subject matter to students. According to (Andini & Hobri, 2017; Pujayanto et al., 2017; Uliyandari et al., 2021), The PBL model emphasizes the effectiveness of learning for the active learning of students.

The PBL model develops thinking skills in students through questions and problem solving during learning (Uliyandari et al., 2021). Authentic questions ways to lead to easier troubleshooting (Chiang & Lee, 2016). Then, the preparation of these answers uses group cooperation and directed questions to approach the solution is given to students (Husein et al., 2019). This learning process affects the concept masterys in students (Made, 2015; Pujani et al., 2018; Tyas et al., 2020).

During the learning process, high student learning activity increases concept masterys in the subject matter. Students show active learning with curiosity on the concept of the subject matter. The process of active learning has a goal to improve learning outcomes for students (Susilaningsih et al., 2019).

Process learning directs students on how to learn during the learning process (Susilaningsih et al., 2019). A directed learning process will increase students' learning motivation (Susbiyanto et al., 2019). Learning motivation supports the level of activity of students during the learning process (Susbiyanto et al., 2019). With high learning motivation in students, they give attention and activeness to the subject matter during the learning process. According to Chiang & Lee (2016), learning motivation is the key to student activity during the learning process. The activeness of students affects learning outcomes about concepts in the subject matter.

The appropriate learning model improves student learning outcomes, and this is a pedagogical skill of the teacher or teacher candidate (Prayitno et al., 2018). In PBL, The activeness of learning from students increases concept masterys in the subject matter (Wiwik & Rambitan, 2018). The learning model of PBL also improves the cognitive aspects for higher-order thinking in students (Anwar et al., 2019; Hidayati & Retnawati, 2016; Made, 2015; Nursa'ban et al., 2019; Uliyandari et al., 2021).

CONCLUSION AND SUGGESTION

The learning model of PBL ("problem-based learning"), the improvement of students' skills in concept mastery of subject matter through the activeness learning of students. In the experimental class, students scored higher than the control class in every aspect of learning activities. Meanwhile, the n-gain number, the experimental and control class have the category of increasing effectiveness of the medium, but the experimental class has a higher score.

PBL in the learning process is expected to be implemented in all learning materials to make students have better higher order thinking skills, and problem-based learning should be more developed with many innovations. Hopefully, this current research can contribute to the advancement of education, especially in the field of science in junior high schools.

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