THE EFFECT OF PROBLEM-BASED LEARNING GENERAL CHEMISTRY MODULE ON STUDENT CONCEPT MASTERY

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Abstract. This study aims to determine the effect of a general chemistry module based on problem-based learning (PBL) on students' conceptual mastery of the subject of stoichiometry. This research method used quasi-experimental with a population of all 3rd-semester mathematics education study program at Nommensen HKBP University of Pematangsiantar Academic Year 2020/202 which was determined by random sampling consisting of 2 classes, namely the control class (a class that is taught with a general chemistry module without learning model) and experimental class (a class that is taught with a general chemistry module with problem-based learning model). The results showed that the percentage mastery of the concepts C1, C2, C3, C4, C4, C5, and C6 in the control class and experimental class were as follows, C1 : 22,50% ; 25,00%, C2 : 30,00% ; 7,50%, C3 : 12,50% ; 17,50%, C4 : 27,50% ; 40,00%, C5 : 7,50% ; 7,50%, and C6 : 0% ; 2,50%. The testing hypothesis of this study using t-test that t-count > t-table of 10,83 < 2,02. The result showed that there was an effect of the general chemistry module based on problem-based learning on students' mastery of a concept.
Keywords*:* The Module, PBL, and Concept Mastery

INTRODUCTION

Education is a very strategic learning process in educating students so that it must be done professionally (Bhakti & Maryani, 2017). The dominance of educators in the learning process has less impact on the development of thinking skills if they only memorize concepts and are less able to connect concepts in real life (Suyanti, 2010). Learning objectives will be achieved if educators can create enjoyable learning for students by implementing various strategies, models or, methods and, various learning media, to foster student interest and motivation to learn (Maesaroh, 2013). If you pay attention to the implementation of learning, an educator always plays an active role in the implementation while those who play an active role as subjects are students, so that the interaction between educators and students is very necessary (Buhungo, 2015).

The digital era is an era of disruption in which technological and communication advances occur very rapidly. In this era, the types of skills possessed and existing jobs have begun to shift (Mercier & Sperber, 2011). This shift will affect the world of education, which is a means to prepare the next generation who can meet the needs of employers. Along with the increasingly rapid development of technology towards the digital era, the current implementation of learning needs to be supported by the modernization of learning in higher education. The learning process requires an educator to have the right strategy in carrying out learning activities, ideally, the design of teaching materials that are made should be able to help improve students' thinking processes and other activities that are in line and following the learning objectives to be achieved (Izzati et al., 2013). However, in reality, there are still some problems faced by students during the learning process. Learning is a combination of elements consisting of lecturers and students, teaching materials, materials, and procedures that influence each other to achieve learning objectives. The implementation of learning carried out by lecturers by

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applying various strategies, models or, methods and various learning media can foster student interest and motivation so that learning designed by lecturers becomes fun for students.

Elementary chemistry has many areas with conceptual difficulties for students. The area of difficulty lies in the microscopic scale chemical studies which tend to require concepts to understand them and logical thinking so that students' creative thinking skills are needed (Flynn, 2015). One of the chemical materials is solubility which is a common material in learning chemistry at secondary schools, associations and, undergraduate levels, solubility material is often found in students in everyday life and is an interesting material (Günter, 2018). Besides, solubility is a material that is difficult to study because of its abstract nature and heavy mathematical calculations (Rahmi et al., 2017). Students can complete chemical calculations correctly, but do not understand the underlying chemical concepts (Gultepe et al., 2013). The difficulties experienced by students in understanding concepts can be influenced by several factors, namely the lack of supporters in mastering concepts, the learning process, and environmental factors of students (Faika & Side, 2013), which have an impact on students' conceptual understanding. . The low understanding of students towards chemical concepts will affect the way students think in solving problems that arise as a result of the development of science and technology (Manurung, 2019). Technology is one important aspect that can be used to create attractive teaching materials for students (Gabby et al., 2017). Teaching materials have a significant role in supporting the learning process (Linda, 2018).

The module is one type of learning media or aids in the form of learning tools that are used to assist teachers in conveying messages and subject matter to students effectively and efficiently (Hardianto, 2012). The modules that have been used in the learning process still have a simple layout and the content is only the subject matter. Modules like this make students tend to feel bored in studying the material on each subject, so a problem-based learning-based basic chemistry module is needed so that it can attract students' interest and mastery of concepts in basic chemistry courses.

The implementation of learning by utilizing modules can support lecturers to create variations in teaching and help students learn independently. Chemistry learning today is required to be more meaningful and oriented towards developing the potential that is contained in students. An aspect that is no less important is learning that can build student character to become individuals who are not only qualified academically but also socially, emotionally and, spiritually intelligent (Saptorini et al., 2014).

PBL is a learning approach that uses real-world problems as a context for students to learn about critical thinking and problem-solving skills, as well as to acquire essential knowledge and concepts from course material or subject matter (Sudarman, 2018). The application of learning with a problem-based learning model can improve creative thinking and student learning outcomes (Tarigan & Manurung, 2015). Students' ability to master concepts can be developed optimally by implementing modules with problem-based learning. Problems obtained by students in the basic chemistry module are given the right solution to overcome them so that the chemical concept has the implication that the concept that is studied more deeply can construct students to provide alternatives to the existing constraints.

Based on the description above, the researcher is interested in conducting entitled "The Effect of Basic Chemistry Module Based on Problem Based Learning on Students' Concept Mastery in Stoichiometric Materials".

METHOD

This research was conducted for 4 months from September to December 2020 which was conducted online in the Odd Semester Mathematics Education Study Program, Academic Year 2020/2021 Nommensen HKBP University of Pematangsiantar. The study population was all students of the Mathematics Education Study Program, while the sample in this study was 40 people, which were taken by random sampling.

The general chemistry module that has been made has gone through the validation stage using expert validators. The available modules have been adjusted to the semester plans for general chemistry courses. The instrument used was a written multiple-choice test of 30 items which had been validated using expert validators. The instrument is used to measure students' mastery of concepts on stoichiometric material. Mastery of the concept in question is knowledge competency based on Anderson and Krathwohl's taxonomy (Wilson, 2016). The indicators of knowledge are remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5), and creating (C6). The data analysis techniques used consisted of: (1) percentage of concept mastery, (2) normality testing, (3) homogeneity testing, and (4) hypothesis testing.

RESULTS AND DISCUSSION

The module is an individual learning medium. The general chemistry module is designed as a tool to help lecturers in the network improve students' mastery of concepts in the Mathematics Education Study Program. The use of modules is expected to help students to take an active role in developing their potential independently, which is oriented towards the achievement process. Before the module is given to students, the instructions for its use must first be explained so that when lectures run using the module there are no obstacles faced by students.

According to Arend, the Problem Based Learning model is a learning model that provides authentic and meaningful problem situations to students, which can serve as a stepping stone for investigation and investigation (Hamdani, 2015), students need new knowledge to find solutions (Nugroho et al., 2013). For the student level, it is very relevant to the problem given, then they find a solution to the problem found.

Mastery of concepts can help students to construct an understanding of previously owned concepts on the achievement of mastery of the concepts being studied (Arends, 2012). According to Cakir, mastery of concepts is very important and should be the focus of attention in the science learning process, and prioritized over memorization. A good learning process does not only convey information about concepts but also pays attention to the process of conveying concepts. Organizing a good learning process can use a problem-based learning model that suits the needs of basic chemistry courses.

The students' mastery of concepts data obtained from the written test in the form of multiple choices is obtained as follows :

Table 1 Percentage of Control Class (E-1) and Experimental Class (E-2) Concept Mastery on the Material Stoichiometry

Class	Percentage of Concept Mastery					
	C1	C2	C3	C4	C5	C6
E-1	22,50	30,00	12,50	27,50	7,50	0,00
E-2	25,00	7,50	17,50	40,00	7,50	2,50

Based on the data in Table 1, it is available that the mastery of the level of the concepts C1 E-2 > E-1, this data shows that the level of conceptual understanding of students in general chemistry courses develops well at E-2 Level C2, that E-1 > E-2, this data shows that the level of concept describes E-2 students as not having an optimal impact. Level C3 that E-2 > E-1 this data means that the level of the concept of calculating students for E-2 is well developed. Level C4 that E-2 > E-1 data means that the level of student analysis concept has developed well. Level C5 shows that the concept level data connects for E-2 = E-1, this means that the effect of each class obtains the same results. While the level C6 E-2 > E-1 this data shows that the level of concept comparing students to E-2 is well developed. the effectiveness of the application of problem-based learning general chemistry modules for students at the evaluation level (C4) with a percentage of 40%.

The graph of the percentage of concept mastery in the experimental class and the control class explains how much the percentage of achievement achieved by students for each level of concept mastery.

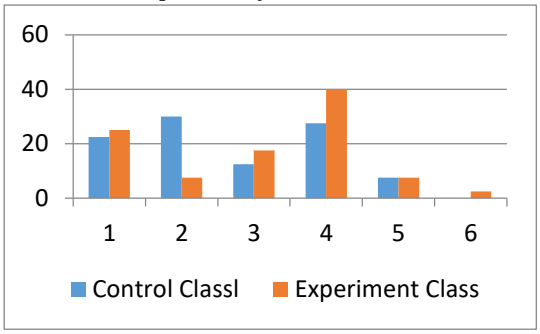

Figure 1 Graph of Percentage of Control Class Concept Mastery (E-1) and Experiment Class (E-2) Material Stoichiometry

Based on Figure 1, explains that the percentage of mastery of the concepts C1 to C3 has increased in the experimental class. However, the percentage of mastery of the concepts C4 to C6 decreased in the experimental class. The control class experienced an increase in mastery of the concept of C1 and C2 after C3 to C6 experienced a drastic decrease. When observed from the graphic image above, the percentage of the concept mastery is evenly distributed by the students, while the control class only masters the concept of C6 which is not developed. It can be analyzed that the percentage of the concept mastery of the experimental class is more dominant than the control class.

Table 2 Results of Student Concept Mastery Data Processing Using General Chemistry Module Based on Problem Based Learning on Stoichiometry Material

Data	Class	
	Control	Experiment
Sample	40	40
Average	50,68	77,63
Normality	2,17	
Homogenity	0,87	
t-test	10,83	

Based on Table 2, the students who were used as research samples were 40 people for each class (experiment and control). After processing the data, it was found that the average value of the control class was 50.68 and the experimental class was 77.63, so it was found that the average value of the experimental class was higher than the control class. However, the effectiveness of the effect of problem-based learning general chemistry modules on concept mastery of stoichiometric material for the experimental class was 34.71%. The concept mastery data obtained were normally distributed and homogeneous. This means that the available data meets the data analysis requirements to be tested through the t-test. From the results of the t-test, it can be obtained t-count > t-table with a significance level of 10.83 < 2.02. The results of the study indicate that there is an effect of problem-based learning based on basic chemistry modules on students' mastery of concepts on stoichiometric material.

CONCLUSION

Based on the data obtained from the research conducted, the results showed that the mastery of the concepts of Mathematics Education Study Program students used basic chemistry modules based on problem-based learning with an average value of 77.63 while the mastery of concepts used basic chemistry modules without a model with an average value. amounting to 50.68. It can be concluded that the use of problem-based learning-based basic chemistry modules has a major effect on students' mastery of concepts.

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