JISE 11 (2) 2022 : 142–148

Journal of Innovative Science Education

http://journal.unnes.ac.id/sju/index.php/jise

The Effect of Using Problem Based Chemical Module Assisted by the Quartchem Card on Students Learning Outcomes and Creativity

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Article Info

Article History :
Received
January 2022
Accepted
March 2022
Published
August 2022

Keywords:
Problem Based Learning, Quartchem, Creativity

Abstract

Following education in the 21st century, students must have a lot of skills one of them is creativity. Fresh graduates of vocational high school required to have high creativity. Low students' creativity being a problem that must be faced by the teacher. This study aims to find the effect of the problem-based chemistry module with the help of Quartchem cards on student learning outcomes and student achievement in chemistry learning about chemical bonding. Grade X motorcycle engineering which consists of three class used for population of this research. The sampling technique was carried out by cluster random sampling with class X TSM 3 as the experimental class and class X TSM 2 as the control class. Data collection was carried out by three methods, there are documentation method, test method, and observation sheets method. The test method is used to measure students 'cognitive learning outcomes using the pre-test and post-test question instruments, while the observation sheet method is used to measure students' creativity using the student's creative product observation sheet. The test method is used to measure students 'cognitive learning outcomes using the pre-test and post-test question instruments, while the observation sheet method is used to measure students' creativity using the student's creative product observation sheet. The results showed that the experimental class learning outcomes average was 86.20 and the control class was 81.96 while the average creativity of the experimental class was 84.379 and the control class was 72.3. The results of data analysis with the t-test of the right side for student learning outcomes obtained t_{count} 2.212 and for creativity obtained t_{count} 11.94 with t table 1.67 shows that there is an effect of problem-based chemistry modules assisted by Quartchem cards on student learning outcomes and creativity.

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p-ISSN 2252-6412
e-ISSN 2502-4523

INTRODUCTION

Thinking is a complex and reflective endeavor, even thinking can be said to be a creative experience (Tawil & Liliasari, 2013). Rational thinking activities include memorizing, imagining, classifying, organizing, comparing, evaluating, analyzing, synthesizing, deducing, and concluding (Novak, 1979). Complex thinking is called high-order thinking which consists of critical thinking, creative thinking, problem solving, and decision making (Costa, 1985). Process of creative thinking is a process that combines logical thinking and divergent thinking. Divergent thinking is used to look for ideas to solve problems, while logical thinking is used to verify these ideas into a creative solution (Sari et al., 2017). Creative thinking ability is very important for students to follow every learning process, to explore their brand ability, so that they can produce many solutions from the problem with their creativity. The ability to think that is always nurtured will shape students' ability to think creatively (Haryani et al., 2016). For doing creative thinking activities, creativity must be needed.

Creativity is a person's ability to create something completely new or a combination of existing works into a new work that is done through interaction with their environment to face problems and find alternative solutions through new ways of dealing with a problem (Intan, 2019). Creativity is the result of interaction between individuals and their environment, data processing ability and information obtained ability from the experience and knowledge that their has acquired during their life, both within the school, family, and from the community (Ardi, 2013). one's creativity is different with other. Creativity is the skill to determine new relationships, seeing subjects from a new perspective, and form a new combinations of two or more concepts that have been printed and thought of. Creativity is a guide for knowledge, imagination and evaluation. Creative ideas arise because of awareness of our environment or external stimuli (Evans, 1994). Creativity that has been designed properly through the right learning experience will result in a significant increase in creative performance (Daly et al., 2016).

Ipek (2012), found that creativity needed for students in order to be able to solve problems with the various ideas and ways they have. Hasan & Rahman (2012) also stated that creativity in solving problems can increase students' awareness in problem solving. Creative students can achieve learning success. This is in line with the findings from the research of Muhammad Naseer and his team from the Department of Education, University of Sargodha Pakistan. Naseer (2012) stated "*Finding clearly support the importance of instruction in creative thinking skills to increase the probability of academic success for all student, especially those having low grades or IQ level.*"

Currently, creativity is in the spotlight by various parties, especially in the world of education. The rapid development of education requires students to have several skills, one of which is creativity. High creativity that students have will help students to be able to solve problems well and be able to compete in the world of work. Based on preliminary interviews conducted by researchers with alumni of SMK NU Bodeh, at this school, 50% of the 74 students who graduated in 2018 from the school have not found jobs, while 50% have worked, but many of them work not in accordance with their respective skill fields. they excel at school. Such as working as a waitress in a restaurant, a shop assistant and as an internet cafe keeper. This shows that graduates from vocational high schools who should be prepared to work it is difficult to get a job and do not have the courage to open an independent business because their creativity is classified as low which ultimately results in an increase in unemployment in Indonesia. For this reason, there is a need for a paradigm shift in the learning process from learning conditions where students only focus on the teacher to be changed to sharing knowledge, seeking (inquiry), finding active approaches so that there is an increase in understanding (not memory) which in the end students can better understand a material provided by the teacher through this new approach.

Selection of the right learning model will affect the quality of learning which has implications for student creativity (Ardi, 2015). Problem-based learning (PBL) is a method that can make students active, creative, and innovative in solving problems (Novi, 2015). Yusmanidar (2017) states that PBL with practical methods can affect science process skills and student learning outcomes. The problem-based learning model carries the main idea that

learning objectives can be achieved if educational activities are focused on tasks or problems that are authentic, relevant, and presented in a context (Aziz, 2015).

Learning using the Problem Based Learning model has a positive effect on student learning outcomes (Mayasari, 2015). Another problem that arises in chemistry learning in SMK is the allocation of a little learning time so it is necessary to design a time-efficient but still interesting learning, namely problem-based learning with modules and Quartchem cards. Learning with games encourages students to be more enthusiastic in following lessons.

The Quartchem card was adopted from the quartet card game applied in chemistry learning. A game consisting of a number of picture cards with a description that clarifies the contents of the cards (Indah, 2013). Quartchem card is a card game that contains the keywords of a material. The Quartchem card is a picture card that is equipped with a caption for each image. This Quartchem card is applied in a problem-based module. Modules are a form of teaching material that is packaged in a comprehensive and systematic manner, which contains a set of planned learning experiences designed to help students master learning objectives (Tri, 2015). The main objective of the module is to increase the efficiency and effectiveness of learning in schools, both time, funds, facilities, and manpower to achieve optimal goals (Prastowo, 2011). The existence of a module will help students describe something abstract, for example by using pictures, photos, charts, schemes and others. Likewise, complex material can be explained in a simple way, according to the level of thinking of students, so that it becomes easier to understand (Nasution, 2016).

METHODS

This research was conducted at SMK Nahdatul Ulama Bodeh, Pemalang. . Grade X motorcycle engineering which consist of three class used for population of this research. The sampling technique was carried out by cluster random sampling with class X TSM 3 as the experimental class and class X TSM 2 as the control class.

The data collection method was carried out in three ways, namely the documentation method, the test method, and the observation sheet method. The documentation method is used to find initial data in the form of a list of alumni who have worked from BKK SMK NU Bodeh. The test method is used to obtain learning outcomes on chemical bonding material, as well as the observation sheet method to measure student creativity.

The instruments in this study were syllabus, lesson plan implementation, problem-based chemistry module, Quartchem card, student creativity product observation sheet, and post-test questions obtained from the calculation of test questions in class XI TKJ students.

The problem-based chemistry module is applied to chemical bonding material, in which there are PBL phases written in detail to guide students to easily carry out learning activities with the PBL model online. Quartchem cards are used at the beginning of the lesson to build students' interest in chemical bonding material and so that students know the outline of chemical bonding material to be studied.

The design used in this study was a control group pre-test-post-test design.The data from this research is in the form of quantitative data, which is in the form of data on student learning outcomes obtained from the posttest results and assessment data on student product creativity. The data were analyzed by means of the one-sided mean difference test.

RESULTS AND DISCUSSION

The data from this research consisted of early stage data analysis and final stage data analysis.

Early Stage Data Analysis

Data analysis was the initial stage of data in the form of a normality test and a population homogeneity test aimed at determining the research sample. Based on data analysis, it is found that the population is normally distributed and homogeneous so that the determination of the research sample can use the cluster random sampling technique. The results of the normality test can be seen in Table 1.

Table 1. Results of the population normality test

Description	X TSM 1	X TSM 2	X TSM 3
$x^2_{compute}$	1.31	5.67	3.80
x^2_{tabel}	7.81	7.81	7.81
description	Normally distributed	Normally distributed	Normally distributed

Based on Table 1, it is obtained that x^2_{count} for each data is smaller than x^2 table with 3 degrees of freedom and a significance level of 5%, it can be said that the population data is normally distributed. The results of the population homogeneity test can be seen in Table 2.

Table 2. Data on Population Homogeneity Test Results

	Data	Description
x^2_{count}	4.516	Homogen
x^2_{tabel}	7.81	

Based on Table 2, it can be seen that both the experimental and control classes are homogeneous at the significance level = 5%.

Final Stage Data Analysis

Data analysis of the final stage of hypothesis testing using the one-sided average difference test for data on student learning outcomes and student creativity. Student learning outcomes were obtained based on the posttest results of chemical bonding material. The results of the pretest and posttest scores for the experimental class and control class can be seen in Table 3.

Table 3. The pretest and posttest scores

	Lowest score		Higest score		Mean	
	Control	Experimen	Control	Experimen	Control	Experimen
Pretes	30	31	62	53	45.13	40.17
Postes	68	68	91	98	81.96	86.20

The results of the calculation of the estimated average learning outcomes obtained by the experimental class learning outcomes averaged at least 68, a maximum of 98, while the control group averaged a minimum of 68 learning outcomes at a maximum of 91. Calculation of sample normality obtained results for the experimental class the value of tit = 5.26, the control class obtained the value of tit = 4.51, with the criteria α = 5% and dk = k-3 obtained t count=7,81. Because $t_{count} < t_{table}$ it can be concluded that the two classes are normally distributed.

The average difference test for one right side aims to determine the effect of learning using chemistry modules assisted by Quartchem cards on student learning outcomes and creativity. so it can be proven that learning using problem-based chemistry modules assisted by Quartchem cards has a positive effect on student learning outcomes and creativity.

One-sided average difference test for student learning outcomes.

The results of the calculation of the hypothesis test for student learning outcomes can be seen in Table 4.

Table 4. The results of one-party right hypothesis test

Data	T_{count}	t_{table}	Criteria
Pretest	0.16	1.67	Ha rejected
Postest	2.212	1.6730	Ha received

Based on Table 4. Testing of the right side of the pretest value obtained t_{count} is not greater than t_{table}, with 67 degrees of freedom and a significance level of 5%, then Ha is rejected. This means that the pretest average value of the experimental class and the control class before being treated is the same. While the one-sided test for the post-test value is divided by t count is greater than t table with 67 degrees of freedom and a significance level of 5%, then Ha is accepted. It can be stated that the average class learning outcomes using problem-based chemistry modules assisted by Quartchem cards are

higher than the average class learning outcomes using the method applied by partner teachers.

This research is in line with Sulistyani's research (2017) which found that problem-based modules have an effect on improving student learning outcomes in economic subjects in class XI IPS at SMAN 1 Bandar Lampung. Khotim's research (2015) also found the same thing, namely the problem-based imia module can improve students' conceptual understanding of acid-base material.

Test the one-sided mean difference for student creativity.

This test was conducted to prove the hypothesis which states that the average creativity value of the experimental class is better than the control class, so that it can be proven that learning using problem-based chemistry modules assisted by Quartchem cards has a positive effect on creativity. The results of hypothesis testing for student creativity can be seen in Table 5.

Table 5. The results of one-party right hypothesis test

Data	T_{count}	t_{table}	Criteria
Creativity	11.94	1.6730	Ha received

The right-hand one test for the creativity value of the experimental class and the control class is determined that t is greater than t table with 67 degrees of freedom and a significance level of 5%, then Ha is accepted. It can be stated that the average class creativity using the problem-based chemistry module aided by the Quartchem card is higher than the average class creativity with the method applied by the partner teacher.

The same results are shown in Utomo's research (2014) that the PBL (Problem Based Learning) problem-based learning model also affects the creative thinking skills of grade VIII students of SMPN 1 Sumbermalang, especially on the subject of the Human Motion System.

Some people use assessment to obtain information that is applied in various ways but only to improve learning outcomes (Griffin & Nix 2003). Long-term assessment is considered not only as a test or any kind of formal test but a good assessment consists of various kinds of evidence showing students' techniques for answering questions through discussion, conducting oral interviews, conducting experiments (Tyler, 1949).

According to Ali and Asrori in Intan (2019) creativity is a person's ability to create something new through interaction with the environment to face problems and find alternative solutions to problems through new ways of dealing with situations. The presentation of problems in the PBL model trains students to think about alternative ways of solving them. The more often students are presented with a problem, the more skilled students will be in finding solutions to the problem. The thought process of students in finding alternative problem solving encourages students to stimulate their creativity. The problem-based chemistry module helps students solve problems more easily through the PBL phases which are clearly stated in the module. This difference resulted in the creativity of the experimental class being better than the control class.

On the experiment class, the teacher applies learning using problem-based chemistry modules with the help of Quartchem cards. The learning model used is a problem-based learning model which consists of 5 phases. The first phase is organizing students on the problem, in this phase the teacher gives questions as problems to students to solve.

Teacher gives problems at the beginning of the lesson with a question and answer activity. Through this activity, students can link events in everyday life with existing theories. With a lot of problem solving exercises, students have skills and dexterity and are accustomed to working on analytical questions and do not require a lot of time to solve these problems. This was done to determine the development of higher-order thinking skills and to train students in analyzing cases deductively, which were then used by students as hypotheses or temporary conclusions from questions given by the teacher (Huda, 2013).

The second phase is organizing students to learn, in this phase students are guided to collaborate in finding references to answer questions previously given by the teacher. The third fasse is guiding individual and group investigations, in this phase the teacher encourages students to collect as many reasons as possible information that is suitable for conducting investigations through experiments. Students are taught to be active investigators and can

use appropriate methods to solve the problems they face. The fourth phase is developing and presenting the work, in this phase students learn to present the results of their experiments and present them correctly in front of the class. The fifth phase is analyzing and evaluating the problem-solving process, in this phase the teacher reflects and evaluates the investigations that have been carried out by students in the processes they use.

Description above is in accordance with the theory which states that problem-based learning provides opportunities for students to collect and analyze data completely in solving the problems faced. Therefore, students can build their own concepts they learn, and can develop thinking skills based on problem solving. The focus of this learning model is solving problems related to learning material, not how the teacher delivers learning material. In problem-based learning, students work together in groups so that there is an exchange of ideas that can build problem solving.

Quartchem cards are used twice, namely series 1 regarding electron stability and series 2 regarding types of chemical bonds. The use of Quartchem cards as a game that aims to increase students' attractiveness to the chemical bonding material to be taught and to build concepts independently by students, so that students know the outline of the chemical bonding material to be studied.

In the control class, learning is carried out with a problem-based learning model without modules. The teaching and learning process was carried out in 4 meetings. Posttest conducted at the eighth meeting aims to measure cognitive abilities after receiving treatment. The difference with the experimental class is that the control class teaching and learning activities do not use a problem-based chemistry module with a Quartchem card. The reference used is only the chemistry textbook of technology and engineering SMK.

Researchers experienced several obstacles during the learning process, namely (1) male students who sat in the backseat sometimes were noisy and (2) students did not pay attention when the researcher explained the material. The efforts made by researchers to overcome these obstacles were (1) sanctioning male students for working on problems in front of the class and (2) researchers inviting students to understand the importance of chemical bonding material for everyday life.

CONCLUSION

There are differences in learning outcomes and creativity of students who experience learning using problem-based chemistry modules assisted with Quartchem cards and students who experience learning without problem-based chemistry modules assisted by Quartchem cards.

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