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The Effect of Scaffolding-Based Problem-Based Learning on Creative Thinking Skills on Hormone Materials

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Abstract. The ability to think creatively is one of the higher order thinking skills so it is very important in biochemistry learning. The purpose of this study was to determine students' interest in learning in problem-based learning by providing scaffolding and without providing scaffolding and to see the effect of students' interest in learning in problem-based learning by providing scaffolding on students' creative thinking abilities. The design in this study used an explanatory sequential design with a total sample of 88 students of the Jambi University chemistry education study program. The instrument used in this study was a learning interest questionnaire with 17 statements and a creative thinking ability test question with a total of 10 questions. The data collection procedure was carried out, namely the researcher distributed a questionnaire instrument of student learning interest when learning using the PBL model and learning using the scaffolding integrated PBL model. After distributing the interest in learning questionnaire, the researcher then distributed the instruments for testing the ability to think creatively. The sampling technique used was total sampling. The data analysis technique used descriptive test, t-test and simple linear regression test. The results obtained are that there are differences in students' interest in learning when learning using the PBL model integrated with scaffolding and learning using the PBL model. In addition, there is an influence of students' interest in learning on students' creative thinking skills using a problem-based learning model with scaffolding.
Keywords: interest in learning, creative thinking skills, problem based learning, scaffolding

Introduction

Biochemistry studies how enzymes work, which is studied from the perspective of biochemistry and its relation to biological sciences (Komatsu & Urano, 2019). Biochemistry in learning generally consists of materials related to introduction to biochemistry, enzymes, biomolecules, hormones, metabolism, expression, carbohydrates, fats, gene replication, photosynthesis, lipids, molecular genetics, biooxidation and the Krebs cycle, amino acids and proteins (Perumcheril, 2017; Voet, 2016; Żymańczyk-Duda, 2016). In this study, the biochemical material studied is about hormones. Material about hormones can be said to be a difficult concept for students, because it includes concepts about structure, function and process as well as the relationship between these structures, functions and processes (Sopian, 2019). Therefore, biochemical material

about hormones is very important material to learn and material about hormones is able to improve one's creative thinking ability.

Creative thinking is a cognitive process of individuals to carry out analytical activities, plan, evaluate, conclude, and make the right decisions (Ceylan, 2020). A person's creative thinking can be measured and seen based on the aspects of flexible thinking, detailed thinking, original thinking, and fluent thinking, so as to improve one's ability to solve problems, student creativity and learning achievement will increase (Khoiri et al., 2017) . Creative thinking is a very important ability for every individual to have (Faturohman & Afrianskyah, 2020; Pangestu & Yunianta, 2019). Therefore, creative thinking is very important to pay attention to and improve. One of the efforts that can be done to improve creative thinking skills in biochemistry learning is by giving sacffolding to students.

Giving scaffolding to students can be in the form of assistance given only at the initial stage of learning and then the assistance provided is reduced so that students are responsible for solving the problems given (Lutfia & Zanthy, 2018; Park et al., 2020). The scaffolding given can be in the form of instructions, questions, or keywords that are given gradually to students. Scaffolding can also be in the form of providing various sources related to the problem to be solved (Chen & Tseng, 2019; Tullis et al., 2015). Therefore, scaffolding can be in the form of any assistance according to the needs of students in learning, especially in the study of biochemistry of hormone materials. The provision of scaffolding is very helpful in the learning process so that students can more quickly achieve the learning objectives that have been set (Uum et al., 2017). In addition, the provision of scaffolding in learning can increase student interest in learning.

Students' interest in learning must continue to be grown because interest is one of the factors that affect the process and student learning outcomes. According to Qomariah & Ketut (2016), interest in learning is defined as an interest or feeling of liking for a lesson so that the experience, knowledge, and activities of students increase in learning activities. During the learning process, the interest of students will cause students to focus and be conducive to learning. Thus, the existence of an interest in learning can cause students to be more motivated and have the initiative to continue learning and gain experiences and understandings that are beneficial for themselves. Moreover, with the scaffolding provided in learning activities.

Scaffolding given during learning can vary between educators. In research conducted by Haruehansawasin & Kiattikomol (2018), regarding the provision of scaffolding in learning, the results obtained that the scaffolding provided led to an increase in student achievement and students were more active in learning. The difference between this study andHaruehansawasin & Kiattikomol (2018), including the level of the sample used, namely in this study the research sample was students from the university level, while in this research Haruehansawasin & Kiattikomol (2018) the research sample is students at the high school level. In addition, the difference between the two studies is that in this study, what the researchers studied included variables about creative thinking, interest, and scaffolding in problem-based learning. While in research Haruehansawasin & Kiattikomol (2018), the variables studied are about achievement and learning activity as well as scaffolding in problem-based learning (PBL). Therefore, it is these differences that become the novelty in this study which is expected to complement existing research.

Based on the explanation described above, the researcher raised this research to reduce the gap in previous research and as a new thing given for research related to the provision of scaffolding in learning. The novelty given is the object of the study in the form of biochemical material about hormones, where researchers will analyze how scaffolding affects students' creative thinking abilities. Thus, the researchers divided the objectives of this study into three as follows:

1. To describe students' interest in learning and creative thinking skills in learning biochemistry of hormone-based materials using scaffolding.
2. Knowing the differences in student interest in learning hormone biochemistry based on scaffolding using the PBL model and without using the PBL model.
3. The effect of giving interest in learning to students' creative thinking skills in learning biochemistry of hormone-based materials using scaffolding.

Methods

This type of research is quantitative which is studied. Quantitative research is an approach used to obtain research data and information using several data collection instruments for further quantitative analysis (Darmaji et al., 2019; Silalahi, 2018). Quantitative data is in the form of numbers that contain numerical information for calculation or data analysis (Perdana et al., 2020; Sumual, 2017; Walsh, 2015). The function of using quantitative data in research is to obtain measurable data and sure (Rahma & Sumarti, 2016). Therefore, researchers have prepared several instruments as a data collection tool that will be distributed to research subjects.

The instruments used in this study were in the form of a student interest questionnaire, and a question sheet about students' creative thinking skills in biochemical learning of hormone-based materials using scaffolding. The questionnaire instrument for students' interest in learning consists of 17 statements, while the question sheet for students' creative thinking skills consists of 10 essay questions. Where the student's creative thinking ability question sheet is in the form of an essay question that can be filled out by students with a description of the answers that are considered appropriate. While the student learning interest questionnaire is in the form of a Likert scale with four answer options provided, namely a score of 1 is very bad, a score of 2 is not good, a score of 3 is good, and a score of 4 is very good.

Table 1. Questionnaire Grid of Student Interest in Scaffolding-Based Biochemistry Learning

No.	Indicator	No Item
1.	Feeling happy	2, 3, 4, 6, 7
2.	Interest	1, 5, 8, 9, 10
3.	Attention	11, 12, 13, 14
4.	Student Engagement	15, 16, 17

Table 1, the above presents a questionnaire on student learning interest in scaffolding-based biochemistry learning which consists of 17 statements. The interest questionnaire consists of four indicators, namely feelings of pleasure, interest, attention, and student involvement. As for the grid of students' creative thinking ability test questions, it is presented in Table 2.

Table 2. Grid of Creative Thinking Ability Test Questions on Hormone Material Biochemistry Learning

No	Question Indicator
1	Can give 4 concrete examples that hormones play a role in controlling all metabolic processes and body activities
2	Can prove correctly and in detail, by including 4 examples that hormones are produced when needed
3	Can prove correctly and in detail, by including 2 concrete examples that children who have difficulty eating, only consume milk, but their physical and mental growth remains normal

4	Skilled in thinking 2 different concrete examples that some people with diabetes mellitus need insulin supply from outside, for normal activities.
5	Can do a correct and detailed analysis of the concept of how hormones work by including 2 examples.
6	Able to analyze correctly and in detail with 2 examples of internal factors that affect hormone production.
7	Can analyze correctly and in detail with 2 examples of external factors that affect hormone production.
8	Can prove correctly and in detail, by including 3 examples of the benefits of hormones for living things in their daily activities.
9	Can analyze in detail, related to the hormone melatonin and thyroxine hormone by including 4 examples of the consequences of excess melatonin and thyroxine hormones
10	Can analyze in detail, related to the types of hormones that can stimulate the formation of gastric juice

Table 2 presents the lattice of the instrument for the test of students' creative thinking skills in the biochemical learning of hormone material. The question grid consists of 10 questions related to hormones which are expected to improve students' creative thinking skills. Where the score given for each question is 0 to 10, and the scores for each question will be added up so that the final score is obtained from the test results about students' creative thinking abilities. Where, all the instruments that have been prepared will be given to each sample from the population involved.

The population involved in this study were all students of chemistry education at the Jambi University class of 2020 with a total of 88 students. From the total population, the researcher took all members of the chemistry education students to be used as research samples, which were selected using the total sampling technique. This technique is called total sampling because all members of the population are used as research samples (Chen et al., 2020; Fitriani et al., 2021). This technique was chosen by the researcher, because it is considered a technique that is considered appropriate for a sample of less than 100 people. According to Putri et al., 2018, the use of the entire population as a research sample can reduce the possibility of errors in sampling. Therefore, the researcher used a total sampling technique. Furthermore, after determining the sample used in the study, the researcher will analyze the data that has been collected to draw conclusions.

The analysis of research data that has been collected is by using descriptive statistics and also using inferential statistics (Amrhein et al., 2019; Hasnidar & Elihami, 2019). By using descriptive statistics, researchers will obtain the average, percentage, minimum and maximum values, and the magnitude of the frequency (Fitriani et al., 2021). Through descriptive statistics, it will be known how students' interest in learning and creative thinking skills in scaffolding-based biochemistry learning on hormone material will be known. The researcher involved two tests, namely the assumption test (in the form of normality test, homogeneity test, and linearity test), and hypothesis testing (in the form of T test and regression test) with a narrative explanation of the results of data analysis (Fitriani et al., 2021). The assumption test aims to determine whether the data is normally distributed, homogeneous, and linear or the data is the other way around (Nurhadisah et al., 2014; Saidaturrahmi et al., 2019). The hypothesis test in the form of a T test was carried out to determine the difference in the average student interest in biochemistry learning based on scaffolding on hormone material using the PBL model and the average student interest in learning biochemistry based on scaffolding on hormone material without using the PBL model. While the simple linear regression hypothesis test was conducted to determine the effect of interest in learning

on students' creative thinking skills in scaffolding-based biochemistry learning. The provisions of the normality test, homogeneity test, and linearity test are if the significance value obtained is less than 0.05 (Sig. < 0.05) then it can be interpreted that the data is not normally distributed, not homogeneous, and not linear, whereas if the value is not the significance obtained is greater than 0.05 (As'ari, 2018; Herawaty et al., 2018; Putri et al., 2020; Rachmah et al., 2019; Rini et al., 2021). Furthermore, for the provisions of the T test and regression, if the significance value obtained is less than 0.05 (Sig. <0.05), it can be interpreted that the data has a difference and has a significant effect. Whereas if the significance is greater than 0.05 (Sig. > 0.05) then it can be interpreted that the data has no difference and has no significant effect.

Results and Discussion

In this study, first the researchers wanted to see how students' interest in learning by using the PBL model and student interest in learning using the PBL model integrated scaffolding. Table 3 is the result of a descriptive test of students' interest in learning biochemistry using a problem based learning model without scaffolding.

Table 3. Students' interest in learning biochemistry using the PBL model without scaffolding.

Interest						
Range	F	%	Category	mean	median	Mode
1.00-1.75	4	4.5	Not very good			
1.76-2.50	44	50.0	Not good	2.49	2.44	1.88
2.51-3.25	39	44.3	Well			
3.26-4.00	1	1.1	Very good			

Based on the results of the description test of students' interest in biochemistry learning using the PBL model without scaffolding, it was in the bad category with a percentage of 50%. With an average value of 2.49, a median of 2.44 and a mode of 1.88. After knowing the students' interest in learning by using the PBL model without scaffolding, the researchers then measured the students' interest in learning biochemistry using the PBL model integrated with scaffolding. Following are the results of students' interest in learning biochemistry using the PBL model integrated scaffolding described in Table 4.

Table 4. Students' interest in learning biochemistry using the scaffolding integrated PBL model

Interest						
Range	F	%	Category	Mean	Median	Mode
1.00-1.75	2	2.3	Not very good			
1.76-2.50	36	40.9	Not good	2.61	2.62	2.38
2.51-3.25	39	55.7	Well			
3.26-4.00	1	1.1	Very good			

Based on Table 4, the results of the description test of student interest in biochemistry learning using the problem based learning model integrated scaffolding are in the good category with a percentage of 55.7%, and an average value of 2.61, median 2.62 and mode 2.38. After conducting a descriptive test, the researcher tested the hypothesis, namely the t test and simple linear regression test. Before testing the hypothesis, the researcher conducted a prerequisite test first. The prerequisite tests

carried out are normality, homogeneity, and linearity tests. The following are the results of the normality test of student learning interest questionnaires and the essay test instrument for creative thinking skills.

Table 5. Normality Test Results

	Kolmogorov-Smirnov		
	Statistics	Df	Sig.
Questionnaire of interest in studying biochemistry with the PBL model	.091	88	.067
Questionnaire of interest in learning biochemistry with scaffolding integrated PBL model	.087	88	.099
Creative thinking ability essay test questions	.976	88	.108

Table 5 shows the results of the normality test of student learning interest questionnaires and essay test questions. The results of the normality test of the interest in biochemistry questionnaire with the PBL model obtained a significance of 0.067, the interest in biochemistry questionnaire with the scaffolding integrated PBL model is 0.099 and the critical thinking ability essay test questions are 0.108. After conducting the normality test, the researcher conducted a homogeneity test. The homogeneity test carried out is the homogeneity test of student learning interest questionnaires using a PBL model and learning interest using a scaffolding integrated PBL model. The following table 6 is the results of the homogeneity test of student learning interest questionnaires using a PBL model and learning interest using a scaffolding integrated PBL model.

Table 6. Homogeneity Test Results

Variable	Levene Statistic	df1	df2	Sig.
student learning interest questionnaire using a problem based learning model	3.424	1	88	.552
Questionnaire of students' interest in learning by using an integrated problem-based learning model of scaffolding	2.688			.679

Based on table 6 the significance value of the homogeneity test for the student learning interest questionnaire using the problem based learning model is 0.552, while the student learning interest questionnaire using the scaffolding integrated problem based learning model is 0.679. Furthermore, the researchers conducted a linearity prerequisite test which aims to see whether the data from the two variables used have a linear relationship. The results of the linearity test can be seen from Table 7.

Table 7. Linearity Test Result

		Sum of squares	df	Mean square	F	Sig
Questionnaire of learning interest using the scaffolding integrated pbl model*creative thinking skills	Between Groups (Combined)	1096.917	25	43.877	1.298	.202
	Linearity	1.934	1	1.934	.057	.812
	Deviation from Linearity	1094.983	24	45.624	1.350	.137
	Within Group	2095.981	62	33.806		
	Total	3192.898	87			

The results of the linearity test described in table 7 show that the results of the linearity test obtained a significance valueQuestionnaire of students' interest in learning by using a problem based learning model integrated with scaffolding on creative thinking skills is 0.137. After the prerequisite test was carried out and it was known that the data was normally distributed, homogeneous, and linear, then the hypothesis test was then carried out, namely the T test and simple linear regression test. T-test was conducted to see the differences in students' interest in learning using a problem-based learning model and students' interest in learningby using an integrated problem based learning model of scaffolding. Table 8 is the result of the T test.

Table 8. T-Test Results of Students' Learning Interest

		F	Df	Sig.(2-tailed)
Interest in learning to use the PBL model	Equal variances assumed	12.081	87	.000
	Equal variances not assumed		79.351	.000
Interest in learning by using a scaffolding integrated PBL model	Equal variances assumed	.209	87	.030
	Equal variances not assumed		77.99	.030

Based on table 8, it is obtained that the value of sig. (2-tailed)student interest in learning questionnaire using the problem based learning model is 0.000 and interest in learning using the problem based learning model integrated scaffolding 0.030. Next, a simple linear regression test was carried out to see the effect ofinterest in learning by using an integrated problem-based learning model of scaffolding on creative thinking skills. The results of the simple linear regression test between interest in learning using a problem based learning model integrated with scaffolding on creative thinking skills are described in Table 9.

Table 9. The Result of the Variance test

Model	Sum of Square	Mean Square	F	Sig.
Regression	652.233	612,252	112.243	.000
Residual	4557,442	2.467		
Total	1270,023			

If seen in Table 9, it is known that there is an influence between students' interest in learning using the scaffolding integrated pbl model on critical thinking skills. This is indicated by the significance of the results obtained that is equal to 0.000 < 0.05. Based on the results of the study, it was found that there was an influence between interest in learning using the problem-based learning model integrated with scaffolding on creative thinking skills. This can be seen from the significance value obtained, which is 0.000 less than 0.05. Meanwhile, based on the R-square value, it was obtained that the effect of interest in learning by using a problem-based learning model integrated with scaffolding on creative thinking skills was 0.673 or 67.3%.

Based on the results of the descriptive test of student learning interest questionnaires, it can be seen that students' interest in learning with the PBL model is in the bad category with a percentage of 50%. Meanwhile, students' interest in learning

using the PBL model integrated with scaffolding is in the good category with a percentage of 55.7%. It can be seen that the provision of scaffolding in biochemistry learning has an effect on students' interest in learning.

After conducting a descriptive test, the researcher then tested the hypothesis. Before testing the hypothesis, the researcher conducted prerequisite tests, namely normality test, homogeneity test, and linearity test. Based on the results of the normality test, it was found that the student's interest in learning using the PBL model was 0.067, the interest in learning using the scaffolding integrated PBL model was 0.099, and the students' creative thinking ability data was 0.108. Furthermore, the homogeneity test of students' interest in learning using the PBL model obtained the results of 0.552, while the student's interest in learning using the PBL integrated scaffolding model was 0.679. And the result of students' interest in learning using the PBL model integrated with scaffolding on creative thinking skills is 0.137. Based on these results, it can be said that the data has met the prerequisite test requirement (Putri, et al., 2020)

Next, the hypothesis test is carried out, namely the T test and the testsimple linear regressionWhere based on the results of the T test to see the differences in student interest in learning using the PBL model and student interest in learning using the PBL model integrated with scaffolding. It can be seen that the value of sig.(2-tailed) obtained isinterest in learning to use the PBL model as much as possible0.000 daninterest in learning using a scaffolding integrated PBL model of 0.030. Based on these results, it can be said that there are differences in students' interest in learning using the PBL model and students' interest in learning using the PBL model integrated with scaffolding. This is because the significance value obtained is smaller than 0.05 (Tarumasely, 2020). Furthermore, when viewed from the testsimple linear regressionit can be seen thatthe effect of student interest in learning using the PBL model integrated with scaffolding on creative thinking skills is 0.673 or 67.3%. Based on these results, it can be categorized that the influence between students' interest in learning using the scaffolding integrated PBL model is in a strong range.

The integration of sacfolding in problem based learning has been studied by a researcher named Haruehansawasin & Kiattikomol in 2018. In this study, researchers examined the scaffolding approach that was suitable for low-achieving students using the PBL learning model which showed that the provision of scaffolding in learning was able to improve students' learning achievement and activate discussion skills during learning. In addition, the research conducted by Mardeleni, et al. (2018) also shows that there is a difference in the average mathematical problem solving ability of students who study using a scaffolding integrated problem based learning model compared to students who receive conventional learning in terms of students' initial mathematical abilities. Yuliastantu Research, et al (2014) also obtained the results that there was a significant difference between students' physics learning outcomes using the PBL model accompanied by the scaffolding technique and the direct instruction learning model in physics learning. The difference between this study and the research conducted by Haruehansawasin & Kiattikomol (2018), Mardeleni, et al. (2018) and Yuliastantu, et al. (2014) is in the subject and research variables. Where in the research of Haruehansawasin & Kiattikomol (2018), Mardeleni, et al. (2018) and Yuliastantu, et al. (2014) the research subjects are junior high and high school students. While in this study the subjects used were college students. In addition, the variables in this study are student learning interest using the PBL model and student learning interest using the scaffolding integrated PBL model, as well as creative thinking skills. While the variables in previous research are problem solving abilities and learning outcomes.

The position of this research is to complement the gap of several relevant studies that have existed before. Through this research, it will provide new information and findings in accordance with the objectives of the research conducted by the researcher so

that the findings from research conducted by previous researchers will be complemented by this research and follow up on the weaknesses that exist in previous research. Research has proven that PBL can improve students' problem solving abilities (Mayasari, et al., 2016; Ulhaq, et al., 2020; Munzil, et al., 2022). In this study, the researchers discussed in more detail the application of the PBL model. Researchers not only discuss the problem-based learning model used in learning, However, the researcher conducted research by integrating the provision of scaffolding in learning using a problem based learning model and describing how the level of student interest in learning using the PBL model and students' interest in using the PBL model integrated scaffolding. PBL is able to increase student interest in learning activities (Nizarullah, et al., 2017). The problems presented in this PBL model are real or authentic problems that occur in real life (Anggraini, et al., 2022; Fadhilah, et al., 2022). Through this study, researchers found that students' interest in learning biochemistry using the PBL model and using the integrated sacffolding PBL model had differences.

The application of the problem-based learning model integrated with scaffolding is the right learning approach, because it can have broad implications for improving the world of education. Problem-based learning models that are integrated into scaffolding can not only increase teacher success, but also improve student attitudes and learning outcomes towards learning. The scaffolding integrated PBL learning model can increase students' creativity in solving various problem topics, starting from identifying, formulating, and choosing the best solution to solve a problem, and students' creative and critical thinking. In addition, the problem-based learning model integrated with scaffolding can be used to improve learning outcomes. Learning with this model makes classroom learning more interesting and quality that allows students to improve communication skills, analyze problems, and improve student attitudes. The role of scaffolding really helps teachers maximize the achievement of learning objectives and students' thinking and scientific process abilities. In line with this, Puspitaningsih, et al., (2018) in his research stated that both procedural and conceptual scaffolding provided by the teacher through the PBL learning model was able to increase students' higher-order thinking skills in problem solving by 42.5% in terms of high and low abilities. Thus, problem-based learning integrated with scaffolding can improve the quality of learning in the world of education and provide competitive, active and innovative learning conditions.

Applying a PBL on scaffolding is the right solution in learning. This is because it provides various benefits that play an important role in the world of education. Therefore, the researcher recommends integrating scaffolding into the biochemistry learning of other materials and learning to use a problem-based learning model that also applies to other courses/learning topics. Integrating scaffolding into the use of problem-based learning models is considered suitable to improve teacher skills in the classroom and improve teacher performance in the learning process. In addition, the integration of scaffolding into problem-based learning models can increase students' interest in learning.

Conclusion

Based on the research that has been done, the conclusions that can be drawn are: The results of the description test showed that students' interest in learning with the PBL model was in the bad category, while students' interest in learning with the scaffolding integrated PBL model was in the good category. There are differences in students' interest in learning with the PBL model and students' interest in learning with the PBL model integrated with scaffolding. This can be seen from the significance values obtained, namely 0.000 and 0.030. In addition, there is a strong influence on students' interest in learning with the scaffolding integrated PBL model on creative thinking skills of 0.673.

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