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CREATIVE THINKING OF CHEMISTRY AND CHEMISTRY EDUCATION STUDENTS IN BIOCHEMISTRY LEARNING THROUGH PROBLEM BASED LEARNING WITH SCAFFOLDING STRATEGY

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ABSTRACT

This study aimed to describe students' creative thinking skills in a problem-based learning model with scaffolding in the Biochemistry course. This is mixed-method research with an explanatory sequential research design with a sample of 173 students from the Chemistry Education and Chemistry study programs, Universitas Jambi. In this study, the researchers only used the experimental class. The sampling technique used is total sampling and purposive sampling. Data were collected using observation sheets, test instruments, interview instruments, and response questionnaires. Quantitative data analysis used is hypothesis testing in the form of ANOVA test with Post-Hoc Scheffe test and T-test. The findings of this study indicate that the ANOVA test results showed a significant difference in the average creative thinking (cognitive) test results and student response questionnaire results in scaffolding-based integrated biochemistry learning. In addition, there is also a significant effect between cognitive test results on student responses in scaffolding-based integrated biochemistry learning. So it can be concluded that there are differences in the creative thinking skills of chemistry education students and chemistry students in using scaffolding integrated problem-based learning models in Biochemistry courses.

Keywords: biochemistry; creative thinking; scaffolding; problem-based learning

INTRODUCTION

Learning seeks to change students' input, who are not educated to be educated, who do not know to know. Even if students' attitudes, habits, or behavior do not reflect their existence as superior or positive individuals, they still have good attitudes, habits, and behavior. Learning is not just reading, listening, writing, and doing assignments; it is also expected that changes in behavior can occur as a result of the learning process. The purpose of learning itself is expected to change knowledge, attitudes, and skills during learning activities (Hendratmoko et al., 2017; Rini et al., 2021). In addition, learning is also expected to improve the cognitive, affective, and psychomotor domains (Yusuf, 2017; Latifah et al., 2019).

Creative thinking is one of the higher-order thinking skills (Sutrismo et al., 2019). Creative thinking is a cognitive process used by individuals to analyze, make plans, carry out investigations, then make conclusions and identify assumptions until the right solution is finally obtained (Ceylan, 2020; Syahrial et al., 2021). Creative thinking can be measured from the aspects of fluent thinking, flexible thinking, original thinking, and clear thinking to increase students' creativity and problem-solving skills and improve learning outcomes (Khoiri et al., 2017). Thus, creative thin-

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king is an important aspect to be considered in the learning process. Improving creative thinking skills can be done by applying the problem-based learning (PBL) model.

Problem-based learning (PBL) is a learner-centered learning model that intends to train students to solve a problem given by the teacher by providing the right solution (Ediansyah et al., 2019; Naji et al., 2020). The use of the PBL model in learning makes students process information appropriately and creatively, overcome and solve the problems given, and improve students' learning skills and achievements (Sakir & Kim, 2020; Tanti et al., 2021). The PBL model in learning can provide an authentic learning experience for students that integrates learning in real, everyday life that can stimulate the growth of students' creative thinking skills. This is because the PBL model involves a problem that must be overcome which can indirectly improve students' creative thinking skills, especially with the actual learning experience gained (de la Puente Pacheco et al., 2019). Students' creative thinking skills can be continuously improved, one of which is by integrating the PBL model with scaffolding.

Scaffolding is defined as assistance given to students in learning, and then the assistance provided will be reduced so that students can take responsibility for solving the problems given (Ilmiyah et al., 2018; Park et al., 2020). Scaffolding (providing assistance) used in the PBL learning model can be done by giving a question, keyword, signal, or giving instructions that are carried out in stages. The provision of scaffolding can also be made by providing sources related to the problems being addressed and provided by guiding students (Chen & Tseng, 2019). In addition, scaffolding can be provided by utilizing technology, for example, through computer programs. Thus, scaffolding can be provided in various forms tailored to students' needs and appropriate for use in problem-based learning. One of the courses that quite often utilizes problem-based learning is the Biochemistry course.

Biochemistry is a lecture material that discusses organisms, the structures that make a substance, and their transformations, often called metabolism (Kurniawati & Jailani, 2020). In general, biochemical material includes an introduction to biochemistry, biomolecules, enzymes, metabolism, expression, gene replication, amino acids and proteins, carbohydrates, fats, molecular genetics, heme, and hemoglobin metabolism, bio-oxidation and the Krebs cycle, lipids, carbohydrates, and nucleic acids (Perumcheril, 2017). In this case, the researcher will study the sub-materials of amino acids and proteins. The most important units that make up the structure of proteins are called amino acids, while the functional components of all body cells are called proteins (Dailami et al., 2019). This sub-material is studied in biochemistry learning, where a problem-based learning model integrated with scaffolding can be applied to make learning more meaningful.

Based on an initial study conducted by giving creative thinking skill test questions to 30 chemistry education students and 30 non-educational students (pure chemistry) from January 2021 to March 2021, the average creative thinking skill test in Biochemistry learning was 66.75 for chemistry education students and 61.75 for non-educational students (chemistry). So the form of effort that needs to be made so that students' creative thinking skills increase in biochemistry learning is the application of the scaffolding integrated PBL model.

Providing scaffolding in learning was investigated by Song and Kim in 2021 with the research subject, namely postgraduate students providing information that the provision of scaffolding by utilizing technology can increase participation, improve students' learning performance, and improve students' independent learning skills. Scaffolding is often given to the PBL model, such as research conducted by Haruehansawasin and Kiattikomol (2018), that learning by providing scaffolding can improve students' learning outcomes and activate discussion learning. Previous studies on using scaffolding in PBL have shown positive effects on PBL in various fields of education. This is because the PBL learning model can improve students' creative thinking skills (de la Puente Pacheco et al., 2019). Research on creative thinking skills carried out by McCarthy (2018) in the learning process shows that students' creative thinking skill has increased with appropriate learning models. In this research, the model used is problem-solving in the counseling process and does not examine the integrated scaffolding in learning (PBL) in the Biochemistry course.

The lack of research that examines whether PBL scaffolds can improve students' creative thinking skills makes researchers interested in conducting this research and adding other innovations. Other innovations provided relate to the materials used in research and the integration of scaffolding into PBL learning. The materials used in this research are amino acids and proteins in biochemistry courses. Therefore, in this study, the researcher intends to examine the effect of the problem-based learning scaffolding model in biochemistry courses on creative thinking skills and to see how students respond to using the PBL scaffolding model in biochemical studies.

Based on this description, the researcher intends to fill the gap related to using the scaffolding integrated PBL model, which is expected to improve creative thinking skills. The formulation of the problem raised by the researcher is "How does the implementation of the problem-based learning model with scaffolding affect the level of student's creative thinking skills, which are reviewed based on differences in study programs?' Then the researchers described the research objectives, namely: To describe students' creative thinking skills in a problem-based learning model with scaffolding in the Biochemistry course in the Chemistry Education Study Program and the Chemistry Study Program and review the responses given by students to the use of the PBL model integrated scaffolding in biochemistry learning.

METHODS

This type of research is a mixed-method with an explanatory sequential type, i.e., qualitative and quantitative data are analyzed sequentially and separately (Kamid et al., 2021a; Kamid et al., 2021b; Syaiful et al., 2021). Sequential explanatory design is done by collecting quantitative data first for further analysis. After that, it is continued with qualitative data collection and analysis (Creswell, 2013). Quantitative data serves as descriptive data in the form of numbers, while qualitative data serves to deepen the results of quantitative data (Syahrial et al., 2019). The instrument in this study used creative thinking ability observation sheets, interview sheets, student responses, and creative ability test questions. The observation sheet instrument consists of 16 questions with four graded descriptor scores. A score of 4 indicates very good criteria, a score of 3 criteria is good, a score of 2 criteria is quite good, and a score of 1 is not good (Putri et al., 2020; Putri et al., 2021). The following are content outlines of observation sheets for assessing students' creative thinking skills.

Table 1. Content Outline of the Observation Sheet for the Assessment of Creative thinking Skills

No	Aspect	Indicator	No. Items
1	Sensitivity	Speed of asking questions	1
		Speed of responding to questions	2
		Speed to conclude the problem being discussed.	3
2	Fluency	Generate many ideas in solving problems	4
		Give many ways or suggestions for doing things	5
		Work faster and do more in	6
3	Flexibility	Generate problem-solving ideas or answers to a variety of questions	7
		Can see a problem from different perspectives.	8
		Presenting a concept in a different way (with a slate of presentation, style, and expression)	9
4	Originality	Provide new ideas for solving problems.	10
		Develop or enrich the ideas of others.	11
		Add or detail an idea to improve the quality of the idea.	12
5	Elaborate	Can determine the truth of a question or a problem-solving plan.	13
		Can spark ideas to solve a problem and can implement it properly.	14
		Have a justifiable reason for reaching a decision.	15
		State the reason for the truth of the answer/statement	16

Furthermore, the test instrument for creative thinking skills assesses students' cognitive aspects. The test instrument used is an essay question with five questions. The content outlines of test instruments used are as follows.

Table 2. Content Outline of Creative Thinking Test Instruments

Aspects of Creative Thinking	Question Indicator	No
Sensitivity Fluency Flexibility Originality Elaboration	Can prove correctly and in detail by including five examples of the biological role of protein in facilitating the body's metabolic processes.	1
Sensitivity Fluency Flexibility Originality Elaboration	Skilled in thinking > 4 clear and detailed ideas to prove, including concrete examples, that protein can be used to neutralize xenobiotic compounds entering the body.	2
Sensitivity Fluency Flexibility Originality Elaboration	Can prove two examples of compound structures of amino acids correctly, precisely, and in detail and provide substantial differences between these compounds.	3
Sensitivity Fluency Flexibility Originality Elaboration	Can prove correctly, precisely, and in detail the description of protein compounds' primary, secondary, tertiary, and quaternary structures, explain events that occur during the protein denaturation process and prove why proteins can form a precipitate.	4
Sensitivity Fluency Flexibility Originality Elaboration	Can prove precisely and in detail, five peptide formulas from the given fragments if the Edman analysis shows the N-terminal is in glycine, and with Carbocy peptidase shows that the first amino acid to appear is acidic.	5

After distributing the observation sheets and test questions, the researchers also interviewed several students. This interview aims to deepen the results of the observation sheet and test questions. The interview outlines used are as follows:

Table 4. Content Outlines of Interview Instruments

No	Component	Sub Component	Interview Sheet Number
1	Students' response to Scaffolding integrated learning	Students' response to Biochemistry learning	1,5,7
		Students' attitudes that arise when implementing PBL-scaffolding	2,3,10
2	Measuring students' creative thinking skills in learning using integrated scaffolding in the Biochemistry course	It is easier for students to work on test questions in Biochemistry learning with this learning model and strategy	4
		Students study in groups	6.9
		Students dare to ask questions to educators and friends	8

The research population comprises all Chemistry Education and Chemistry Study Program students who have taken Biochemistry courses. As many as 173 students became the sample in this study, which were obtained using a total sampling technique. The sampling technique with total sampling is done because the number of samples studied is the same as the existing population (Darmaji et al., 2019; Fitriani et al., 2021). The total sampling technique is a sampling technique that is considered the most accurate and can reduce sample errors because the sample error rate will be lower with more samples used (Putri et al., 2018; Ruswati, 2018). The sample in this study consisted of 4 classes. Chemistry education study program, namely regular class A, regular B class, and two classes, regular A and regular B. The chemistry study program will collect data through observation sheets and questionnaire sheets, student responses, and question sheets for amino acids and proteins. Regular class A of the chemistry education study program is 45 students, and regular class B is 43 students. Regular class A of the chemistry study program is 42 students, and regular class B is 43 students. The researchers also conducted interviews with 24 students who were selected based on the purposive sampling technique as research supporting data (Campbell et al., 2020) which is expected to be able to represent the population (Mazen & Tong, 2020).

Data will be collected for analysis to obtain conclusions. Data is obtained from response questionnaires, observation sheets, question sheets, and interview results (Monárrez et al., 2018). The average value helps describe how the students' creative thinking skills differ in each class. Then proceed to test the hypothesis using the ANOVA test, Scheffe further test, and regression test. Then a hypothesis test was carried out in the form of an ANOVA test (with Scheffe further test) to find out the difference between the variables, and the research data there were differences in each class if the significance value obtained was below 0.05 (Gómez-Arízaga et al., 2021). However, before testing the hypothesis, an analysis is carried out using the Shapiro-Wilk normality test and Levene's homogeneity test of Equality of Error Variances homogeneity (Darmaji et al., 2021). While the interview data will be analyzed qualitatively using Miles and Huberman with the stages, namely, reduce, displaying, and concluding (Asrial et al., 2020; Kamid et al., 2020; Syahrial et al., 2020; Maison et al., 2021).

RESULTS AND DISCUSSION

This study begins by conducting a normality test of the results of student responses to the use of the scaffolding-based PBL learning model, which is presented in Table 5.

Table 5. Normality Test of Observation Sheets, Test Sheets, and Response Questionnaires for Chemistry Education Study Program and Chemistry Study Program

Study Program	Instrument	Shapiro-Wilk			
		Statistics	Df	Sig	Class
Chemistry Education	Observation sheet	0.984	43	0.784	A
		0.982	43	0.742	B
	Test	0.952	43	0.069	A
		0.953	43	0.075	B
	Response Questionnaire	0.976	42	0.511	A
		0.963	42	0.192	B
Chemistry	Observation sheet	0.958	43	0.115	A
		0.964	43	0.190	B
	Test	0.961	42	0.156	A
		0.831	42	0.200	B
	Response Questionnaire	0.951	42	0.072	A
		0.951	42	0.067	B

The normality test determines the data's normality, which will be normally distributed if the significance value is more than 0.05 (Syiarah et al., 2021). The researcher's normality test was the normality test of the observation sheet data, test sheets, and response questionnaires obtained from the chemistry education and chemistry study programs.

Based on Table 5, it is known that the normality test scores for the chemistry education study program in class A for observation sheets, test sheets, and response questionnaires are 0.784, 0.069, and 0.511, respectively. Meanwhile, the normality values for the observation sheet, test sheet, and response questionnaire in class B were 0.742, 0.075, and 0.192, respectively. For the chemistry study program, normality test scores were obtained from observation sheets, test sheets, and response questionnaires in class A are 0.115, 0.156, and 0.072, respectively. Meanwhile, for class B, the normality values for the observation sheet, test sheet, and response questionnaire were 0.190, 0.200, and 0.067, respectively. Thus, it can be said that the data obtained from all the instruments used were normally distributed. Next is to test the homogeneity of the observation sheet and test sheet results with the following results.

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Table 6. Homogeneity Test of Observation Sheets, Test Sheets, and Response Questionnaires for Chemistry Education Study Program and Chemistry Study Program

Study Program	Instrument	Statistical Levene	df1	df2	Sig.
Chemistry Education	Observation sheet	0.615	1	86	0.435
	Test	3,481	1	86	0.066
	Response Questionnaire	0.021	1	86	0.885
Chemistry	Observation sheet	0.008	1	83	0.929
	Test	0.298	1	83	0.744
	Response Questionnaire	1.032	1	83	0.313

Based on Table 6 above, the significance of the homogeneity test of the chemical education study program on the observation sheet is 0.435, on the question sheet is 0.066, and on the response questionnaire is 0.885. In the chemistry program, the observation sheet is 0.929, the test sheet is 0.744, and the response questionnaire is 0.313. This means that the data is homogeneous Next, the researchers conducted a linearity test as a condition for a simple linear regression test. The results of the linearity test of the Observation Sheet and the Test Sheet for the Chemistry Education Study Program and the Chemistry Study Program are presented in Table 7 below.

Table 7. Linearity Test of Observation Sheets and Test Sheets for Chemistry Education Study Program and Chemistry Study Program

Study Program				df	F	Sig
Chemistry Education	LO * TEST	Between Groups	Deviation from Linearity	23	1.031	0.444
Chemistry	LO * TEST	Between Groups	Deviation from Linearity	19	0.872	0.617

Based on Table 7, the linearity test value of the creative thinking skills observation sheet and creative thinking test sheet in the chemistry education study program is 0.444. Meanwhile, for the linearity test value of the creative thinking skill observation sheet and the creative thinking test sheet in the chemistry study program, the significance value is 0.617. Thus, the data obtained is linear. Furthermore, the researchers wanted to see the difference in students' responses from the chemical education study program and the chemistry study program to biochemistry learning with the PBL model integrated with scaffolding. The results obtained are presented in Table 8.

Table 8. ANOVA Test of Response Questionnaire for Chemistry and Chemistry Education Study Programs

	Sum of Squares	Df	Mean Square	F	Sig
Between Groups	3281,529	3	1093,843	14,376	.000
Within Groups	12858,629	169	76.086		
Total	16140.158	172			

Table 8 shows the differences in the responses of chemistry and chemistry education students to learning using the Scaffolding Integrated PBL model. This can be seen from the significance value of 0.000. After the ANOVA test was carried out to see the difference in student responses, the following researchers wanted to see further the differences in the response questionnaires of students from the chemistry education study program and chemistry study program using the Scheffe post hoc follow-up test.

Table 9. Post-Hoc Test of Response Questionnaire for Chemistry ande Chemistry Education Study Programs

Multiple Comparison				
(I) Class	**(J) Class**	**Mean Difference (IJ)**	**Std. Error**	**Sig.**
Chemistry Education A	Chemistry Education B	-4,76324	1.87544	,096
	Chemistry A	-10,73981*	1.87544	,000
	Chemistry B	,56091	1.88682	,993
Chemistry Education B	Chemistry Education A	4.76324	1.87544	,096
	Chemistry A	-5,97657*	1.89663	,022
	Chemistry B	5,32416	1.90789	0.054
Chemistry A	Chemistry Education A	10,73981*	1.87544	,000
	Chemistry Education B	5,97657*	1.89663	,022
	Chemistry B	11.30073*	1.90789	,000
Chemistry B	Chemistry Education A	-.56091	1.88682	,993
	Chemistry Education B	-5,32416	1.90789	0.054
	Chemistry A	-11,30073*	1.90789	,000

*. The mean difference is significant at the 0.05 level.

Table 9 shows that class A chemistry education has a significant difference from class A pure chemistry learning, which can be seen from the significance value of 0.000. In addition, there is also a difference between class B and class A chemistry education with a significance value of 0.022. In chemistry class A, there is also a difference with chemistry class B with a significance value of 0.000. Furthermore, the researchers conducted an ANOVA test on the answers to creative thinking questions for students of chemistry and chemistry education. The results of the ANOVA test are listed in Table 10.

Table 10. ANOVA Test of Chemistry Education and Chemistry Student Test Questions

ANOVA STUDENT QUESTIONS					
	Sum of Squares	**Df**	**Mean Square**	**F**	**Sig.**
Between Groups	6631,665	3	2210,555	13.848	,000
Within Groups	26978,410	169	159,636		
Total	33610,075	172			

Table 10 shows that the results of the chemistry and chemistry education student test questions have differences. This is evident from the significance value obtained, which is 0.000. Next, the researchers conducted a post hoc Scheffe test.

Table 11. Post-Hoc Tests for Chemistry and Chemistry Education Student Tests

Multiple Comparison				
Scheffe				
(I) Class	**(J) Class**	**Mean Difference (IJ)**	**Std. Error**	**Sig.**
Chemistry Education A	Chemistry Education B	11.04703*	2.69442	.001
	Chemistry A	-4.68553	2.69442	.391
	Chemistry B	7.72698*	2.71078	.047
Chemistry Education B	Chemistry Education A	-11.04703*	2.69442	.001
	Chemistry A	-15,73256*	2.72487	.000
	Chemistry B	-3.32004	2.74104	.690
Chemistry A	Chemistry Education A	4.68553	2.69442	.391
	Chemistry Education B	15,73256*	2.72487	.000
	Chemistry B	12.41251*	2.74104	.000
Chemistry B	Chemistry Education A	-7.72698*	271078	.047
	Chemistry Education B	3.32004	2.74104	.690
	Chemistry A	-12,41251*	2.74104	.000

In Table 11, it can be seen that the significance value of the results of the class A chemistry education test questions for class A chemistry is 0.001. Class A chemistry education for chemistry B is 0.047, and class B chemistry education for chemistry class A is 0.000. After seeing the difference in the average results of student responses and the results of student test sheets, the researchers will then look at the effect of the creative thinking skill observation sheet variable with the creative thinking question sheet variable for students of the chemistry education study program and students of the chemistry study program. Table 12 is a simple linear regression test table for the chemistry education and chemistry study programs.

Table 12. Coefficient Results in Simple Linear Regression Test from the Results of Observation Sheets and Test Results of Student Biochemistry Questions in the Chemistry Education and Chemistry Study Programs

Study Program	Model	Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
Chemistry Education	1 (constant)	48.006	6346		7/565	0.000
	LO	.301	.087	.350	3.466	0.001
Chemistry	1 (constant)	42,129	16,221		2,597	0.11
	LO	.510	.225	2.42	2.268	0.026

Based on Table 12, it is known that the general equation for simple linear regression is Y = a+bX. Looking at column B in Table 12 for chemistry education study program students, the value (number of non-standard coefficient constants) = 48,006 and the value of b (regression coefficient number) = 0.301. So, the regression equation can be written as Y = 48.006 – 0.301X. The significance value obtained is 0.001, which means that there is an influence on the response to student test results. Meanwhile, for chemistry study program students, the value (non-standard coefficient constant) = 42.129 and the value of b (regression coefficient number) = 0.510. So, the regression equation can be written as Y = 42.129 – 0.510X. The significance value obtained is 0.026, which means that there is an influence on the response to student test results. So the regression equation can be written as Y = 42.129 – 0.510X. The significance value obtained is 0.026, which means that there is an influence on the response to student test results). So, the regression equation can be written as Y = 42.129 – 0.510X. The significance value obtained is 0.026, which means that there is an influence on the response to student test results. Because the value of the regression coefficient is not minus (-), it can be concluded that the ability to think creatively from the observations of students of the chemistry study program (X) has a positive effect on the results of the Biochemistry test (Y).

As for knowing the magnitude of the effect of students' creative thinking skills obtained from observation sheets on student test results in Biochemistry learning in simple linear regression analysis can be seen in Table 13.

Table 13. Results of the Determinant Coefficient of Creative Thinking Skill Regression Test (Observation Sheet) on the Results of the Biochemistry Test Questions for Students of the Chemistry and Chemistry Education Study Program

Study Program	Model	R	R square	Adjusted R square	Std.Error of the Estimate
Chemistry Education	1	.350a	.813	.112	8.37469
Chemistry	1	.242a	.661	.047	16.50510

The magnitude of the influence of creative thinking skills in psychomotor aspects (observation sheets) on creative thinking skills in cognitive aspects (test sheets) in simple linear regression analysis can be guided by the R square value contained in Table 11.

Based on Table 13, the R square value in the chemistry education study program is 0.813, which means the effect of creative thinking skills in terms of psychomotor aspects (observation sheets) on creative thinking skills in terms of cognitive aspects (test sheets) is 81.3%. In contrast, 18, Another 7% are influenced by other variables not studied. While the chemistry study program obtained a value of 0.661, which means that the influence of creative thinking skills in psychomotor aspects (observation sheets) on creative thinking skills in terms of cognitive aspects (test sheets) is 66.1%, while other variables influence 33.9%. After analyzing quantitative data, the researchers then analyzed qualitative data through interviews. The results of the interviews are as follows:Students' responses to biochemistry learning using the scaffolding integrated PBL model got a good response, with the results of the interviews as follows: " I feel happier because I understand more about amino acids and proteins using the scaffolding integrated PBL learning model."

In addition, by using the scaffolding integrated PBL model in learning, students also showed a good attitude with the results of the interviews, namely: "Learning the material of amino acids and proteins using the integrated PBL model makes me more enthusiastic and active so that I become more diligent and my creative thinking skills increase." In addition, based on the results of interviews with students, students understand the material better, and it is easier to work on the questions given. "I can work on the questions well because I understand the meaning of the questions after using scaffolding-integrated PBL-based learning."

Furthermore, students also become trained in forming group collaborations to jointly find solutions to problems given to the amino acid material when conducting learning using the PBL model integrated scaffolding with the following interview results:"I have become more frequent in group discussions with my friends to discuss the topic of problems given to amino acids and proteins in Biochemistry learning using the PBL model integrated with scaffolding." In addition, students have the courage to express their opinions and ask their peers and lecturers in biochemistry learning using the scaffolding integrated PBL model of amino acid and protein with the following interview results: "I have become more confident and brave to express opinions and ask peers and lecturers questions to find solutions to problems that exist in the amino acid and protein material because of learning using the PBL model integrated scaffolding."

The results of quantitative data showing that students from the chemistry education study program have a higher level of creative thinking skills from cognitive and psychomotor aspects are supported by qualitative data obtained from interviews. The results of interviews conducted on students of the chemistry education study program and chemistry study program from class A and class B with ten questions show that students respond well to learning using the PBL model integrated with scaffolding. The average student interviewed responded that the student had a sense of pleasure and was interested in learning Biochemistry with the models and strategies used. Students become more diligent in studying Biochemistry material well because of the use of scaffolding-integrated PBL learning, making it easier for students to complete and find solutions given in Biochemistry learning. Using this learning model, students become more active and have high enthusiasm for Biochemistry learning. In addition, students become more courageous and active in asking questions to peers and teachers.

Based on research conducted by Haerunisa et al. (2021), it is known that the creative thinking skills of student teachers have different levels on each indicator. Where the flexibility indicator is in a low category, which is 56,9 %, the fluency indicator is in the medium category with a percentage of 63,9 %, the elaboration indicator is in the medium category with 63,9%, and the originality indicator is in the medium category with 69,4%. Students' creative thinking skills must improve, especially on the originality indicator. As for non-student teachers, as done by Fatmawati (2011), it is known that the creative thinking skill of students is mostly (50%) categorized into the medium category, a few are in a low category (23.5%) and high (26.5%).

The creative thinking skill of Indonesian students is ranked 115 out of 139 countries with an index of 0.202 (Ulfa & Wijayanti, 2015). These results are lower when compared to countries in Southeast Asia, such as Malaysia at rank 63, Vietnam at rank 80, and Thailand at rank 82. This is because students in Indonesia only focus on the solution given during learning, so if educators modify the more complex questions, many students are not optimal in doing it. Therefore, the education held must be able to develop students' creative thinking skills so that later college graduates can analyze and solve contextual problems that will be faced in everyday life.

Several previous researchers have carried out related research. One of the studies that discussed problem-based learning was conducted by Belland et al. (2020), conducting investigations on the use of learning models. The results show that students preferred to use resources from educators rather than conducting their own research with their ability to find evidence of problem-solving. This supports the statement of Barrows and Tamblyn (1980) about the PBL model in learning that students are more likely to use and develop skills in independent learning, information literacy, and problem-solving if educators do not provide domain-specific knowledge before PBL activities. Based on previous literature, information was obtained that computer scaffolding can assist students in solving problems that can improve students' abilities and arguments through PBL model learning (Belland et al., 2017a; Belland et al., 2017b). However, in a study conducted by Belland et al. (2020), many students do not use computer scaffolding, so they prefer to use only the teacher's resources. This may happen because students have difficulty logging internet connections and are used to learning that only accepts learning from the teacher, so learning is not student-centered. Therefore, this is where scaffolding plays a role in learning, so the integration of scaffolding in PBL learning is very suitable to be applied.

To improve students' creative thinking skills, teaching methods are needed that support the implementation of problem-based learning models with scaffolding to determine the development of students' creative thinking in every step of learning. These methods include the discussion method, the assignment method, the lecture method, and the question and answer method. The first step is the discussion method, which is used in two forms: group discussion and classical discussion. Discussions were conducted in the context of problem-solving, giving rise to various opinions as a form of creative thinking. The things that are done in group discussions are (a) Make a summary of the material and power points; (b) Match the problems made in groups with the problems posed in the classical discussion; (c) Develop problem-solving strategies, including dividing tasks among each group member to prepare the things needed in problem-solving; (d) Seek information/data/facts for problem-solving; (e) Analyze/process the information/data/facts obtained, then construct as an alternative problem-solving. While in the classical discussion, all participants can convey the results of their creative thinking to solve problems. For one problem will be responded to by three participants.

The second step is the method of giving assignments which is carried out in order to prepare students so that they have provisions during problem-solving discussions. Assignments are given, some have to be completed outside of class hours, and some are for class. Next is the lecture method. The lecture method allows educators to orally convey material or explanations of concepts, principles, and facts to students. The use of the lecture method in the application of the problem-based learning model with scaffolding is carried out by providing input/comments in order to conclude the solution to the first phase of the problem, as well as motivating students to be able to bring up new problems that arise as a result of the discussion. Moreover, the 7th stage is to finalize/summarize all the responses/results of students' creative thinking in the context of solving the second phase of the problem. Furthermore, the last method used is the question and answer method, used by the lecturer to determine the level of student understanding of the material being discussed. Questions and answers are also often used to focus students' attention on applying the lecture method. In applying the problem-based learning model with scaffolding, the question and answer method is used in conjunction with the lecture method.

In the problem-based learning model and creative thinking for Biochemistry learning, scaffolding will be provided in the form of 1. Guidance in completing the task of summarizing material from at least five sources (journals, two textbooks in English, and two textbooks in Indonesian) and making power points by a more experienced person, marked by a signature on the college card; 2. Guidance determines the problem and its solution for the responsible group, which will be discussed in a classical discussion by the lecturer in charge of the course. The guidance process is carried out two weeks before serving as the responsible group and according to the agreement; 3. Guidance/direction in group discussions by subject lecturers to formulate strategies and construct information obtained in order to solve problems encountered in classical discussions; 4. Providing direction to students in the context of division and completing tasks that must be completed during lectures; 5. Strengthening so that students have confidence when conveying the results of their creative thinking and believe in the truth of the results of the discussion; 6. Providing motivation so that students are inspired and have the desire to argue and convey the results of their creative thinking, both in the form of ideas for problem-solving and in generating new problems; 7. Facilitating students by informing the sources of literature and data is needed to solve problems and provide sufficient time to develop their creative thinking skills.

Previous researchers have studied the integration of scaffolding in learning: Fajriani et al. (2021), with the results of research that to achieve learning goals and higher-order thinking skills, one of them is creative thinking by providing scaffolding in chemistry learning. The difference between the previous research and that of the researcher is that the research subject was aimed at high school students in the previous study. In contrast, the research subjects in this study were chemistry education and non-educational students (chemistry). In addition, in previous studies, the subjects studied were not explaining the specific material in these chemistry subjects. While in this study, researchers examined the learning of biochemistry, especially on amino acids and proteins.

The research conducted by Diani et al. (2019) found that learning physics using the PBL model integrated with scaffolding was effective for understanding concepts and students' self-efficacy. The difference between this research and what researchers are doing now is that the researchers studied physics learning and aimed at high school students. In contrast, this study is biochemistry learning with university students as research subjects, namely chemistry education students and non-educational students (chemistry). Another difference is that this study aims to determine the effect of PBL-based physics learning with scaffolding on concept understanding and self-efficacy. At the same time, this study aims to describe the results of students' creative thinking skills in learning using the Problem-based learning model in biochemistry courses in the chemistry and chemistry education study programs, as well as analyze student responses to the problem-based learning model integrated with scaffolding. Therefore, more empirical research is needed to realize the importance of scaffolding in learning. Thus, in this study, researchers conducted empirical research to support the importance of scaffolding in learning, especially in the PBL learning model, which can improve students' creative thinking skills.

This study aims to complement the relevant research that has existed before by discussing it more profoundly and providing updates that have not been carried out in previous research. This research will provide new information and findings following 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. The novelty carried out by researchers in the application of the scaffolding integrated problem-based learning model is in the material studied, namely in Biochemistry learning, especially on amino acids and proteins that previous researchers have not studied. Another novelty is that the researchers discussed the model used by integrating the provision of scaffolding in Biochemistry learning, especially on amino acids and proteins. Through this study, researchers found that students' creative thinking skills were different and the selection of an integrated scaffolding model increased the abilities and skills possessed by students increase with authentic learning experiences carried out in biochemistry learning of amino acids and proteins.

Applying the scaffolding integrated learning model (PBL) is the right approach to use in learning because it can have broad implications for improving the world of education. The integrated scaffolding model can foster teacher success in teaching and improve students' attitudes and learning outcomes. Through the scaffolding integrated PBL learning model, students' creativity will increase in solving various problem topics ranging from identification and formulation to choosing the best solution for solving a problem to improve students' creative thinking and critical thinking skills. The use of the integrated scaffolding model can increase the independence of students in learning. The students' attitudes of social solidarity, motivation, and curiosity will increase with the use of models in learning. Learning using this model makes classroom learning more engaging, making students improve communication relationships, analyze problems, and improve student attitudes. So scaffolding integrated learning can provide active and innovative learning conditions that increase the quality of learning in the world of education and have high competitiveness.

Applying the scaffolding integrated learning model (PBL) is the right solution to be applied in learning because it has various advantages that provide an essential role in the world of education. Therefore, the researcher recommends that educators learn using the scaffolding integrated learning model in Biochemistry learning for other materials and also applied to other learning courses/topics. The integration of scaffolding in using the model is considered appropriate to improve teacher professionalism in teaching and improve teacher performance in the learning process. In addition, integrating scaffolding in the learning model can improve students' creative thinking skills.

CONCLUSION

Based on the results of the hypothesis testing conducted, it is known that there are differences in creative thinking skills and responses of students of chemistry education study program and chemistry study program in the use of problem-based learning model integrated with scaffolding. The creative thinking skill of chemistry education students is higher than that of chemistry study program students. In addition, there is also an influence between creative thinking skills on biochemistry learning using the scaffolding integrated problem-based learning model. The use of the scaffolding integrated PBL model is very suitable in learning, especially problem-based learning, because it will improve students' abilities and skills and show the success of an educator in providing teaching in his/her class.

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