Research Article https://doi.org/10.12973/eu-jer.11.3.1349

European Journal of Educational Research
Volume 11, Issue 3, 1349 - 1361.
ISSN: 2165-8714
http://www.eu-jer.com/

How Scaffolding Integrated With Problem Based Learning Can Improve Creative Thinking in Chemistry?

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Received: October 10, 2021 ▪ Revised: December 12, 2021 ▪ Accepted: April 15, 2022

Abstract: This study aimed to describe the differences in students' creative thinking skills in a problem-based learning model with scaffolding in the biochemistry course. This study was designed using a quantitative explanatory research design with a sample of 113 students of the Jambi University Chemistry Education Study Program. In this study, the researcher used the experimental class and control class. The sampling technique used is total sampling and purposive sampling. The research data was taken by observation, test, and interview methods. The quantitative data analysis used was the ANOVA test and continued with the Post-Hoc Scheffe's test. The findings of this study indicate that the results of the ANOVA test indicate a significant difference in the average creative thinking results in terms of psychomotor aspects with the acquisition of significance scores of 0.000. In addition, the results of this study indicate that class A students have higher creative thinking skills than class B and class C. This is because class A students use a problem-based learning model integrated with scaffolding in their learning.

Keywords: *Biochemistry, creative thinking, problem based-learning, scaffolding.*

To cite this article: Ernawati, M. D. W., Sudarmin, Asrial, Damris, M., Nevriansyah, E., Fitriani, R., & Putri, W. A. (2022). How scaffolding integrated with problem based learning can improve creative thinking in chemistry? *European Journal of Educational Research, 11*(3), 1349-1361. https://doi.org/10.12973/eu-jer.11.3.1349

Introduction

The learning objectives ideally reflect changes in knowledge, attitudes, and skills that students can acquire in the learning process (Hendratmoko et al., 2017) by continuing to have up-to-date innovations (Álvarez-Herrero, 2019). One of the psychomotor aspects that can be improved, namely the aspect of higher-order thinking skills, can be done by applying the problem-based learning (PBL) learning model. PBL is a learner-centered learning model with the aim that students can process information appropriately and creatively, overcome and solve the problems given, and improve learning skills and student achievement (Demirel, 2016; Kardoyo et al., 2019; Sakir & Kim, 2020). Therefore, it is necessary to make efforts to make it easier for students to understand the learning material in applying the PBL model. One of the efforts made is to integrate the use of the PBL model with scaffolding.

Scaffolding is interpreted as assisting students, which will only be given in the early stages of learning and during the problem-solving process, then the provision of assistance will be reduced, and students will take over responsibility when they feel they can do so (Lutfia & Zanthy, 2018; Park et al., 2020). However, the provision of scaffolding in learning, especially in chemistry, can help students achieve the goals to be achieved during the learning process, which can improve students' higher thinking skills, one of which is the ability to think creatively (Fajriani et al., 2021).

Creative thinking is an individual process to analyze, plan, evaluate, conclude, identify assumptions, and reach solutions that make the right decision (Ceylan, 2020; Tawarah, 2017). Therefore, creative thinking becomes an essential component and an achievement target for 21st-century learning (Puccio, 2017; Ritter et al., 2020; Suryandari et al., 2021; Taufik et al., 2019). Thus, it is essential to pay attention to creative thinking in learning, one of which is in the biochemistry course on amino acids and proteins.

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Biochemistry is the study of the chemical components of organisms, the structure of their constituent substances, and their transformations in organisms or commonly known as metabolism (Butnariu & Sarac, 2018; Kurniawati & Jailani, 2020). In this study, the biochemical material used is material on amino acids and proteins. This is because amino acids are the primary unit of a protein, and proteins are the main functional and structural components of all body cells (Van Goudoever et al., 2014). So amino acids and proteins are two interrelated things. Therefore, studying biochemistry can be integrated into a problem-based learning model with the help of scaffolding.

Several previous researchers have studied the provision of scaffolding in chemistry learning; namely, Yuriev et al. (2017) suggest that scaffolding in chemistry learning helps teachers improve students' scientific process skills. The advantage of Yuriev et al. (2017) research is that worksheets in chemistry learning are effectively used by teachers and students on buffer solution material and are carried out using a PBL learning model as stated by Álvarez-Herrero and Valls-Bautista (2021) that the project-based learning model allows students to achieve the desired learning outcomes. However, it is undeniable that more empirical research is needed to realize the importance of scaffolding in learning (Wolf et al., 2016).

Scaffolding is often given to PBL, such as research conducted by Pucangan et al. (2018) that conceptual scaffolding in PBL can affect students' problem-solving abilities, which are more improved than before in chemistry learning. The advantages of Pucangan et al. (2018) research, namely the use of PBL in scaffolding in the form of concept maps, have been proven to help students analyze data, draw conclusions, and solve problems because concept maps can narrow the information found and make it easier for students to choose the concept of the material used for solving the given problem. In addition, the PBL model that is integrated with scaffolding can improve creative thinking skills. This is in line with the research of Abdurrozak et al. (2016), where the advantage of this research is that in his research, he stated that learning chemistry with the PBL model was proven to improve students' creative thinking skills. The weakness of the research of Yuriev et al. (2017), Pucangan et al. (2018), and Abdurrozak et al. (2016), namely not combining three variables simultaneously, namely PBL variables, scaffolding, and creative thinking. Each of these studies only uses two variables. Using conceptual scaffolding in problem-based learning can make it easier for pre-service chemistry teachers to understand and recall material concepts. Concepts received by students can be used to analyze problems given during learning (Pucangan et al., 2018). If students succeed in analyzing the given problem based on the concept of the material related to the problem, this can make students' abilities increasingly honed and increasing. Therefore, to prove the existing theory, the researcher conducted this research to find out how the application of the PBL model, when integrated with scaffolding, can improve students' creative thinking skills. The difference between this study with research Yuriev et al. (2017), Pucangan et al. (2018), and Abdurrozak et al. (2016), namely in the biochemical sub-study on protein and amino acids. Another difference is that the subjects studied were college students of the chemistry education study program in this study. In contrast, the subjects studied were high school students in previous studies to see that Integrated Scaffolding with Problem-Based Learning Can Improve Creative Thinking Skills.

Research conducted by Ferdiani et al (2022)that students' creative thinking skills are formed and even increase along with the active learning process in problem-solving models. Research Ferdiani et al. (2022) focuses on creative thinking processes in proposing and solving problems in students with active learning styles, with the results of the study finding differences in behavior between subject 1 and subject 2 at each stage of creative thinking. However, based on the researcher's observations of the behavior of the two subjects at each stage of their thinking, there are similarities in behavior, namely, they tend to be in a hurry to do something, prefer trial and error, and get ideas based on daily experience. The gaps in this study with Ferdiani et al. (2022) are in terms of the variables studied by Ferdiani et al. (2022) namely the existence of active learning style variables that affect students' creative thinking abilities and the absence of scaffolding studies which also affect students' creative thinking abilities.

Based on the explanation above, the researcher intends to conduct research to formulate the problem raised by the researcher, namely, "Can the application of a learning model based on scaffolding improve students' creative thinking skills?' Then the researcher describes the research objectives as follows:

1. Describe students' creative thinking skills in a problem-based learning model with scaffolding in the biochemistry course.
2. Describe the differences in students' creative thinking skills in a problem-based learning model with scaffolding in the biochemistry course.

Methodology

Research Design

This research is mixed-method research with a sequential explanatory design. Sequential explanatory design A hybrid approach to sequential design is a research design that uses quantitative and qualitative data. However, quantitative and qualitative data are collected and analyzed separately and sequentially (Othman et al., 2020). The application of a sequential explanatory design begins with the collection and analysis of quantitative data, then the collection and analysis of qualitative data based on the initial results of quantitative data (Creswell, 2013). The use of quantitative methods serves to retrieve descriptive quantitative data, and qualitative methods serve to deepen and expand quantitative data verification (Rahma & Sumarti, 2016). The researcher used a quasi-experimental design research approach using a posttest-only design in this study. The purpose of using quasi-experimental quantitative research methods is because researchers cannot control all variables when conducting research (Ratnawuri, 2016; Sobarningsih & Rachmawati, 2018).

Setting and Participants

This research was conducted in February 2021 at one of the State Universities in Indonesia in Jambi Province, namely Jambi University. The population in this study were all 2018 Chemistry Education undergraduate students who had taken biochemistry courses. Therefore, the number of students who became the sample in this study was 113. The sample used in this study was divided into three classes, namely regular Class A, regular class B, and regular class C. Data was collected through observation sheets. Regular Class A 35 students, regular class B 40 students, while regular class C 38 students. In this study, the researchers also conducted interviews as supporting data. However, the number of samples used to be interviewed was only 24 students, with 12 male students and 12 female students.

Research Procedure and Data Collection

The instrument used in this study was an observation sheet for assessing creative thinking skills and an interview sheet. The interview sheet is used as a guide when conducting interviews with students about applying the scaffolding integrated PBL model in biochemistry learning. At the same time, the observation sheet is used to record the results of observations during observations in the learning process (Septianti & Afiani, 2020). Researchers used observation sheets to measure students' creative thinking skills in learning amino acid biochemistry. Every individual must possess creative thinking to be able to solve increasingly complex life problems in the current era of globalization. The importance of creative thinking skills makes this component the target/competence of 21st Century educational attainment.

In this study, researchers were assisted by several observers to observe students in three different classes where regular class C was treated with a conventional learning model, regular class B was treated with the PBL learning model only, and regular class A was treated with a scaffolding integrated PBL learning model that all carryout biochemistry learning. In the learning process in class A, the scaffolding integrated PBL model is carried out in the following way:

1. In biochemistry learning, educators explain learning materials, namely protein and amino acids.
2. Determine the level of student development in biochemistry learning based on their cognitive level by looking at the results of previous studies.
3. Group students.
4. Give assignments in the form of tiered questions related to protein and amino acids in biochemistry learning.
5. Encourage students to work and learn to solve problems independently in groups.
6. Provide assistance in guidance, motivation, giving examples, keywords, or other things that can provoke students to think creatively.
7. They are directing students with a high level of development or understanding to help students with a low level of understanding.
8. Conclude the lesson and give assignments.

It is just that in its implementation, there are obstacles experienced. For example, some students are less enthusiastic about participating in biochemistry lessons on protein and amino acids, using a scaffolding integrated PBL model.

During the learning process, the researcher observed using an observation sheet instrument to assess students' creative thinking skills, consisting of 16 items, using four descriptor scores in stages. The preparation of the creative thinking observation sheet must be based on the problems encountered, the nature of the material, the characteristics of the media, the content achieved, the involvement and characteristics of students. Specifications for the design of learning strategies to be developed: problem-based with scaffolding, applying a scientific approach, providing opportunities for students to develop their creative thinking skills, student center, contextual, constructivist, using discussion and question and answer methods. Learning activities consist of problem orientation, group discussion, class discussion, finalization, input from educators/lecturers as a form of motivation, problem-free from participants (elaboration), completion, and finalization. The learning tools will be implemented in biochemistry learning.

The following is a grid of observation sheets for psychomotor aspects of creative thinking skills.

Table.1 Observation Sheet Grid for Creative Thinking Ability

Number	Aspect	Indicator	Number Item
1	Sensitivity	Speed of asking questions	1
		Speed of responding to questions	2
		Speed to conclude the problem being discussed	3
2	Fluency	Generating many ideas in solving problems	4
		It gives 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 differently (with a slate of presentation, style, expression, or expression.	9
4	Originality	Provide new ideas in solving problems.	10
		Develop or enrich the ideas of others.	11
		Adding or detailing an idea to improve the quality of the idea.	12
5	Elaboration	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

Based on table 1. The aspects of creative thinking skills have been described, including sensitivity, fluency, flexibility, originality, and elaboration. The creative thinking skills assessment instrument consists of 16 items with four descriptor scores in graded each.

This observation sheet instrument was developed with the following steps as done by (Sahetapy et al., 2019):

(1) Analysis of research variables, namely examining variables into sub-research as clearly as possible, so that these indicators can be measured and produce the data that the researcher wants. In this case, the variables analyzed are creative thinking with indicators of sensitivity, fluency, flexibility, originality, and elaboration.

(2) Determine the instrument used to measure the variable or sub variable and its indicators. In this study, the instrument used was an observation sheet for creative thinking skills in scaffolding integrated PBL learning.

(3) Researchers arrange a grid or layout the instrument. This grid contains the measured indicators, statements, and question item numbers. This grid is compiled based on the literature where the indicators in this study amount to 5 indicators, namely indicators *sensitivity* consists of 3 statements, namely at numbers 1, 2, and 3. The fluency indicator consists of 3 statements, namely numbers 4, 5, and 6. The flexibility indicator consists of 3 statements, namely numbers 7, 8, and 9. The originality indicator consists of 3 statements, namely 10, 11, and 12. Furthermore, the elaboration indicators are 4 statements, namely at numbers 13, 14, 15, and 16.

(4) Researchers arrange items or questions according to the type of instrument and the number that has been set in the grid. The items that have been written are instrument concepts that must go through a validation process. The number of statements on the observation sheet is 12 items compiled based on the literature on creative thinking skills to be used as data collection instruments.

(5) Instruments that have been made should be tested and used for instrument revision, for example removing unnecessary instruments, replacing them with new items, or improving their content and editorial/language.

(6) The validity and reliability tests are then carried out. The instrument for assessing the observation sheet for creative thinking skills with 16 statement items has been validated by material, construct, and language experts and declared valid, based on the item validity test at the limited empirical test stage and broad trial. The results of the validity of the observation sheet instrument, each item is above the r_{xy} table value (0.29), it means that all items are declared valid. At the same time, the instrument's reliability shows high criteria with an r_{11} value of 0.87 (Ernawati et al., 2019).

In this study, the criteria for becoming an observer are:

1. Have good senses
2. There is interest and willingness to make observations
3. Understand the background of the material to be observed
4. Can distinguish one behavior from another
5. Maintain the relationship between observer and observer
6. Be neutral and do not make decisions quickly

In this study, the activity carried out by the observer was observing students during scaffolding-integrated PBL learning. After observing, the observer would check the activity according to the observation sheet instrument used by the researcher. Then submit the observation sheet to the researcher for analysis.

To minimize intentional actions or situations during the observation, the researcher deliberately did not tell educators and students the main focus of this observation. The observations on the observation sheet are structured and serve as data to be analyzed. After making observations, researchers conducted interviews containing nine questions to support the results of the observation sheet. The following is a grid of creative thinking skills interview questions.

Table 2. Creative Thinking Skills Question Grid

Number	Component	Sub Component	Interview Sheet Number
1	Student responses to Scaffolding's integrated PBL learning	a. Student response to biochemistry learning	1, 5, 7
		b. Student attitudes that arise when implementing PBL learning	2, 3, 10
2	Measuring students' creative thinking skills in learning using PBL integrated scaffolding in the biochemistry course	a. It is easier for students to work on test questions in biochemistry learning with this learning model and strategy	4
		b. Students study in groups	6, 9
		c. Students dare to ask questions to educators and friends	8

Based on table 2, there are two interview components on creative thinking skills: the student response component to PBL learning integrated Scaffolding and the component measuring students' creative thinking skills in learning using scaffolding integrated PBL in the biochemistry course. There are nine questions in total.

The researcher prepared the following interview questions for the respondents:

1. How is student interest in learning biochemistry using the Scaffolding integrated PBL model on amino acid material?
2. Are students using the Scaffolding integrated PBL model more active in the biochemistry learning process on amino acids and can improve students' creative thinking skills?
3. How enthusiastic are students in learning biochemistry using the Scaffolding Integrated PBL model on amino acid material to improve students' creative thinking skills?
4. Is it easier for students to understand the biochemistry learning material using the Scaffolding integrated PBL?
5. What is the attitude of student cooperation when using the Scaffolding integrated PBL model in biochemistry learning?
6. Are students interested and excited by using the PBL model to participate in the biochemistry learning of amino acids?
7. Do students dare to ask questions to lecturers and friends by using the PBL model?
8. Do students often discuss in groups in biochemistry learning using the Scaffolding Integrated PBL model?
9. Do students become more diligent in studying biochemistry using the Scaffolding integrated PBL model on amino acid materials to improve students' creative thinking skills?

After the interview activity ends, the researcher will analyze the overall data that has been obtained to answer the research questions that are formulated and draw the correct conclusions.

Data Analysis Techniques

The data that has been collected will be analyzed to get a conclusion from the research. The data obtained through interviews and observation sheets will be analyzed according to research needs. The result data on the observation sheet will be analyzed quantitatively to find the mean value. The search for the mean value was carried out to describe the differences in students' creative thinking skills in three different classes.

The process of validating quantitative data from the student's creative thinking observation sheet is carried out using the following formula:

$$\text{Interval} = \frac{(\text{Number of questions } x \text{ Maximum score}) - (\text{number of questions x minimum score})}{\text{number of classes}}$$

The interpretation of the score is as follows:

Minimum score: 1

Maximum score: 4

Number (category) of class: 4 (Likert scale)

The following categories of creative thinking skills scores are presented in table 3 below:

Table 3. Creative Thinking Skill Score Categories

Indicator	Score	Category
	3.00-5.25	Not Very Good
Sensitivity	5.26-7.50	Not Good
	7.51-9.75	Good
	9.76-12.00	Very Good
	3.00-5.25	Not Very Good
Fluency	5.26-7.50	Not Good
	7.51-9.75	Good
	9.76-12.00	Very Good
	3.00-5.25	Not Very Good
Flexibility	5.26-7.50	Not Good
	7.51-9.75	Good
	9.76-12.00	Very Good
	3.00-5.25	Not Very Good
Originality	5.26-7.50	Not Good
	7.51-9.75	Good
	9.76-12.00	Very Good
	4.00-7.00	Not Very Good
Elaboration	7.10-10.00	Not Good
	10.10-13.00	Good
	13.10-16.00	Very Good

The table above is a table of creative thinking categories. Where table 3 is used to determine the category of students' creative thinking abilities.

This creative thinking skill observation sheet assessment instrument can be used as a data collection tool because the results of the validity of the observation sheet instrument for each item are above the r_{xy} table value (0.29). In contrast, the instrument's reliability is at a high criterion with an r_{11} value of 0.87 (Ernawati et al., 2019). Thus, the observation sheet that the researcher uses has the reliability to be used in research. This is based on the fact that the validity and reliability test requirements have been met as described above so that this instrument is feasible.

After describing the data, the researcher tested the hypothesis using ANOVA and Scheffe's further test. First, the ANOVA test was carried out to see the differences in the variables used in different environments; the test results stated differences in the data in each class compared if a significance value was obtained below 0.05 (Gómez-Arízaga et al., 2021). However, before testing the ANOVA test, first, an analysis was carried out using the One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variance homogeneity test for homogeneity. Meanwhile, the data from the interviews will be analyzed qualitatively by reducing the data, presenting the data, and drawing appropriate conclusions based on relevant sources.

Results

Based on the results of the data that has been obtained, the data will be processed and analyzed to obtain research conclusions. The first activity carried out by the researcher was to conduct a descriptive test to determine the average level of creative thinking skills of chemistry education students at Jambi University in terms of psychomotor aspects (obtained from observation sheets) obtained from class A, class B, and Class C. a descriptive test table for creative thinking skills can be seen in table 4.

Table 4. Test Description of Students' Creative Thinking Ability Class A

Class	Indicator	Interval	F	%	Category	Mean
A	**Sensitivity**	3.00-5.25	1	0.9	Not Very Good	48.68
		5.26-7.50	7	6.2	Not Good	
		7.51-9.75	13	11.5	Good	
		9.76-12.00	14	12.4	Very Good	
	Fluency	3.00-5.25	1	0.9	Not Very Good	
		5.26-7.50	5	4.4	Not Good	
		7.51-9.75	13	11.5	Good	
		9.76-12.00	16	14.2	Very Good	
	Flexibility	3.00-5.25	-	-	Not Very Good	
		5.26-7.50	5	4.4	Not Good	
		7.51-9.75	12	10.6	Good	
		9.76-12.00	18	15.9	Very Good	
	Originality	3.00-5.25	-	-	Not Very Good	
		5.26-7.50	3	2.7	Not Good	
		7.51-9.75	13	11.5	Good	
		9.76-12.00	19	16.8	Very Good	
	Elaboration	4.0-7.0	1	0.9	Not Very Good	
		7.1-10.0	11	9.7	Not Good	
		10.1-13.0	16	14.2	Good	
		13.1-16.0	7	6.2	Very Good	

Table 4 is a test table for the description of creative thinking in psychomotor aspects. In the psychomotor aspect, five indicators are measured, namely indicators of sensitivity, fluency, flexibility, originality, and elaboration. On the psychomotor aspect in class A, the average is in the very good category. For example, where the sensitivity indicator is categorized as very good with a percentage of 12.4%, the fluency indicator is in the very good category with a percentage of 14.2%, flexibility indicators with a percentage of 15.9% (very good), the originality indicator has a percentage of 16.8% (very good) and elaboration indicators with a percentage 14.2% (very good). The description test results of creative thinking for class B students are presented in table 5 below.

Table 5. Test Description of Students' Creative Thinking Ability Class B

Class	Indicator	Interval	F	%	Category	Mean
B	**Sensitivity**	3.00-5.25	1	0.9	Not Very Good	42,13
		5.26-7.50	10	9.2	Not Good	
		7.51-9.75	17	15.6	Good	
		9.76-12.00	10	9.2	Very Good	
	Fluency	3.00-5.25	7	6.4	Not Very Good	
		5.26-7.50	9	8.3	Not Good	
		7.51-9.75	13	11.9	Good	
		9.76-12.00	9	8.3	Very Good	
	Flexibility	3.00-5.25	7	6.4	Not Very Good	
		5.26-7.50	9	8.3	Not Good	
		7.51-9.75	14	12.8	Good	
		9.76-12.00	8	7.3	Very Good	
	Originality	3.00-5.25	3	2.8	Not Very Good	
		5.26-7.50	13	11.9	Not Good	
		7.51-9.75	14	12.8	Good	
		9.76-12.00	8	7.3	Very Good	
	Elaboration	4.0-7.0	3	2.7	Not Very Good	
		7.1-10.0	16	14.4	Not Good	
		10.1-13.0	17	15.3	Good	
		13.1-16.0	2	1.8	Very Good	

Table 5 is a test table for the description of creative thinking for class B, with all indicators measured in the good category, for example, for sensitivity indicators with a percentage of 15.6% (good), fluency indicators with a percentage of 11.9% (good), flexibility indicators with a percentage of 12.8% (good), originality indicators with a percentage of 12.8%, and elaboration indicators with a percentage of 15.3% (good). As for the results of the creative thinking description test for class C students, it is presented in table 6 below.

Table 6. Test Description of Students' Creative Thinking Ability Class C

Class	Indicator	Interval	F	%	Category	Mean
	Sensitivity	3.00-5.25	3	2.7	Not Very Good	
C		5.26-7.50	19	17.1	Not Good	41,35
		7.51-9.75	15	13.5	Good	
		9.76-12.00	3	2.7	Very Good	
		3.00-5.25	7	6.3	Not Very Good	
	Fluency	5.26-7.50	6	5.4	Not Good	
		7.51-9.75	15	13.5	Good	
		9.76-12.00	12	10.8	Very Good	
		3.00-5.25	2	1.9	Not Very Good	
	Flexibility	5.26-7.50	12	10.8	Not Good	
		7.51-9.75	16	14.4	Good	
		9.76-12.00	10	9.0	Very Good	
		3.00-5.25	8	7.2	Not Very Good	
	Originality	5.26-7.50	12	10.8	Not Good	
		7.51-9.75	17	15.3	Good	
		9.76-12.00	3	2.7	Very Good	
	Elaboration	4.0-7.0	1	0.9	Not Very Good	
		7.1-10.0	19	16.8	Not Good	
		10.1-13.0	20	17.7	Good	
		13.1-16.0	-	-	Very Good	

Table 6 is a test table for the description of creative thinking in terms of psychomotor aspects in class C, which consists of 5 indicators measured, namely indicators of sensitivity, fluency, flexibility, originality, and elaboration. In class C, the creative thinking description test table results are in the good average category. Namely, the sensitivity indicator is in the wrong category with a percentage of 17.1%, the fluency indicator is in a good category (13.5%), the flexibility indicator is in a good category (14.4%), the originality indicator was in a good category (15.3%), and the elaboration indicator was in a good category (17.7%).

After the data was tested descriptively in classes A, B, and C, the researchers conducted a prerequisite test, namely the normality and homogeneity tests. Table 7 is a creative thinking normality test table regarding psychomotor aspects.

Table 7. Observation Sheet Normality Test of Shapiro-Wilk

Class	Statistic	Df	Sig.
Class A	.983	35	.847
Class B	.964	40	.227
Class C	.973	38	.415

The normality test is a test used to see whether the distribution of the data used has been customarily distributed or not. The normality test requires that the significance value must be greater than 0.05 (Fitriani et al., 2021; Putri et al., 2021). The normality test conducted by the researcher is the normality test of the observation sheet data with each class. Based on table 7, it is known that the normality test value in class A for the observation sheet is 0.847. For class B, it is known that the significance value of the observation sheet is 0.227. As for class C, the significance value of the observation sheet is 0.415. So based on the results that have been obtained from class A, class B, and class C, it can be said that the data has been normally distributed because it complies with the test requirements.

After conducting the normality test, the researcher continued with the homogeneity test. The following table 8 is the result of the homogeneity test of the observation sheet data.

Table 8. Homogeneity Test of Observation Sheet

Levene's statistic	df1	df2	Sig.
.275	2	110	.760
.192	2	110	.825

A homogeneity test is used to see whether the data obtained have come from the same population or not. The data is homogeneous if the data significance value is more than 0.05. For example, from table 8, the significance value of the homogeneity test for the observation sheet data is 0.760. Therefore, it can be said that the data obtained came from a homogeneous population.

If the data used is normally distributed and homogeneous, the next step is to conduct the ANOVA test to see the difference in the average value of creative thinking ability of the three classes used. The following table 9 is the result of the ANOVA test.

Table 9. ANOVA *Test Psychomotor Aspect Creative Thinking*

	Sum of squares	Df	Mean square	F	Sig.
Between Groups	1180.519	2	590.260	27.688	.000
Within Groups	2344.985	110	21.318		
Total	3525.504	112			

Table 9 is the result of the ANOVA test to see the difference in the average psychomotor aspects of students from three different classes. Data requirements can have differences if the significance value of the data used is less than 0.05. Therefore, when viewed from the ANOVA table, it is known that the ANOVA test results are 0.000, so the data has a significant average difference.

After carrying out the ANOVA test, the researcher proceeded to the Scheffe Post-Hoc test. The following table 10 is a table for the Scheffe post-hoc test.

Table 10. Scheffe Post-Hoc Test

Mean Difference					95% Confidence Interval	
(I) Class	**(J) Class**	**(I-J)**	**Std.Error**	**Sig.**	**Lower Bound**	**Upper Bound**
Class A	Class B	7.33571*	1.06866	,000	4.6839	9.9876
	Class C	6.55414*	1.08171	,000	3.8699	9.2383
Class B	Class A	7.33571*	1.06866	,000	-9.9876	-4.6839
	Class C	-7.8158	1.04592	,757	-3.3770	1.8138
Class C	Class A	6.55414*	1.08171	,000	-9.2383	-3.8699
	Class B	.78158	1.04592	,757	-1.8138	3.3770

Scheffe's further test was used to see the essential difference between the three classes. Based on table 10, there is a significant difference in the average psychomotor aspects between class A and class B because the significance value obtained is 0.000. There is also a significant difference between classes A and C because the significance value is 0.000. While for class B and class C because the significance value is 0.757, which is greater than 0.05.

After processing quantitative data, the researcher then processed qualitative data from interviews based on the grid that had been compiled and presented as follows:

Student responses to biochemistry learning using the PBL model integrated scaffolding in the biochemistry learning material for amino acids and proteins get good responses, with the results of the interviews, namely:

> *"I feel happy because it becomes easier for me to understand the material of amino acids and proteins by using the scaffolding integrated PBL learning model so that I am very interested, interested, and excited to learn it."*

Based on the interviews that have been conducted, students also showed a good attitude towards the use of the PBL model integrated scaffolding in learning. The following are the results of the interview obtained:

> *"The use of PBL integrated scaffolding in learning amino acid and protein material makes me enthusiastic and active in the learning so that I become more diligent and my creative thinking and critical thinking skills increase because of problems that must be found solutions."*

In addition, responses from students said that it was easier for them to understand and work on the questions given after learning to use the PBL integrated scaffolding model. The results of the interviews obtained are presented as follows:

> *"I can do the questions well and precisely because I understand the meaning of the questions given after learning using the PBL integrated scaffolding model."*

Not only that, students become more daring to express opinions and ask questions to peers and lecturers in studying the biochemistry of amino acids and proteins using the PBL model integrated with scaffolding. This is in accordance with the results of the interview as follows:

> *"I have become more confident and brave to express opinions and ask questions to peers and lecturers to be able to find solutions to problems that exist in amino acids and proteins because of learning using the PBL model integrated scaffolding."*

Discussion

The results show that class A has a higher average creative thinking ability than class B and class C is due to the different treatment between classes. Class A uses the PBL model integrated with scaffolding, class B only uses the PBL model, while class C still uses the conventional model. Another thing that causes class A to have the highest creative thinking ability is because, in the PBL model, there are problems given and group learning so that it can stimulate students to think creatively together to find solutions to existing problems. By the expression Wartono et al. (2018), Ersoy and Baser (2014), PBL learning can improve students' creative thinking skills because there are group activities. In the process, all group members will exchange ideas and knowledge, moreover, with the provision of scaffolding in the PBL learning process. Providing scaffolding in problem learning can help students build fundamental concepts and creative thinking skills in learning, especially in biochemistry. Kusumaningsih and Azman (2018) revealed that the provision of scaffolding has advantages that are not possessed in conventional learning. These advantages increase student creativity, a sense of responsibility in problem-solving, and systematic and organized creative thinking skills. This is the reason why class A has a higher creative thinking ability than class B and class C. These results are reinforced by interview data about the application of PBL integrated scaffolding, which shows that, on average, students have a sense of pleasure and interest in studying biochemistry, students are easier to solve and find solutions given in biochemistry learning, students become more active and have a passion for learning biochemistry. So high, students become more daring and actively ask their peers and teachers.

This research aims to complement the GAP of several existing studies by discussing them in more depth and providing innovations that have not been carried out in previous studies. Previous research relevant to this research has been carried out by Fajriani et al. (2021), who investigated the use of scaffolding in chemistry learning. The results obtained indicate that the provision of scaffolding in learning, especially in learning chemistry, can help students achieve the goals to be achieved during the learning process, namely increasing students' higher thinking skills, one of which is the ability to think creatively. This research has differences and similarities with this study; the similarity between these two studies is that they examine the provision of scaffolding in chemistry learning to improve students' creative thinking skills. Meanwhile, the difference is that this research uses the PBL model to apply scaffolding, which is not carried out by Fajriani et al. research. Furthermore, the subjects in the previous study were high school students, while the subjects in this study were college students.

Researchers found that students' creative thinking skills were different through this study. The selection of an integrated PBL model made the abilities and skills of students increase with authentic learning experiences carried out in biochemistry learning of amino acids and proteins. The application of a scaffolding integrated PBL learning model is the right approach to use in learning because it can have broad implications for improving the world of education.

However, this study also has weaknesses: It takes much time for lecturers/educators. After all, they have to guide and direct (Scaffolding) students before acting as a group at the cost of classical discussions, which takes time, which is a lot for class meetings because students become accustomed to conveying the results of their creative thinking. Therefore, based on the results of previous related studies, it is necessary to innovate regarding the provision of scaffolding in the PBL model to improve students' creative thinking skills. This can be done by developing LKS teaching materials, e-worksheets to modules equipped with scaffolding (can be plots, concept maps, procedures) based on complex types of problems that can train students to solve problems in the form of and improve creative thinking skills.

Conclusion

There are differences in the creative thinking skills of class A, class B, and class C students in using the problem-based learning model integrated with scaffolding in the biochemistry course. Class A students (applied PBL integrated Scaffolding) have the highest level of creative thinking skills, followed by class B (applied PBL model), and the lowest is class C (applied conventional learning). Based on the results of the ANOVA test, it was found that there was a significant difference in average creative thinking skills with the acquisition of Sig. of 0.000. Class A students have higher creative thinking skills than class B and C, with very good criteria. High creative thinking skills in class A students occur because class A students apply the Scaffolding integrated PBL learning model. The scaffolding integrated PBL learning gives good results in biochemistry learning because the average student has good to very good creative thinking skills. The scaffolding integrated PBL method applied in this study worked well and improved students' creative thinking skills. This is because students are more enthusiastic about attending lectures. After all, they are faced with real problems and are involved in finding the right solution with their respective group members. This is supported by Bungel (2014), who suggested that the PBL model integrated with scaffolding can effectively increase students' independence and creative thinking skills in higher education. Therefore, we believe our work contributes to preparing students for future educational challenges.

Recommendations

It is hoped that further researchers who want to measure students' creative thinking skills should modify the learning model studied by integrating scaffolding. It aims to determine the effectiveness of other learning models integrated with scaffolding in improving students' creative thinking skills. Other models referred to by the researcher are the research-based learning (RBL) learning model and the PBL learning model. This research can be used to develop other more innovative learning models by integrating character education. The utilization of technology such as gadgets, smartphones, social media needs to be developed to support the learning process. Technology is not to be shunned but used as well as possible.

Limitations

This study is limited to analyzing the level of creative thinking skills of students in learning biochemistry of amino acids and proteins using a scaffolding-integrated PBL learning model for 2018 undergraduate chemistry education students at Jambi University. This study provides an overview to educators about the level of creative thinking skills of undergraduate students in biochemistry learning, especially the integrated scaffolding PBL model.

Authorship Contribution Statement

Margaret Dwi Wiwik Ernawati: Conceptualization, design, analysis, writing. Sudarmin: Data analysis and writing. Asrial: Editing and writing. Muhammad Damris: Statistical analysis and writing. Eko Nevriansyah: Writing. Riska Fitriani: Writing. Wita Ardina Putri:

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