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# Analysis of problem based learning in the scaffolding design: Students' creative-thinking skills

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**Abstract**

This study aims to determine how students' creative thinking skills are by applying the scaffolding integrated problem based learning (PBL) model in biochemistry learning. The research method used is the mixed method with a sequential explanatory design. The sampling technique used was total sampling and data collection was carried out using creative thinking ability questionnaires, student observation sheets and interviews with students. Based on the results of data analysis carried out, it was found that the results of student observations were in the good category and students' creative thinking abilities were in the very good category. In addition, there is a significant difference in the average value in each class, namely class A with C, and class B with C. The findings in this study are strengthened by the results of interviews where it can be concluded that the PBL model with integrated scaffolding in learning can improve students' creative thinking skills.

Keywords: Biochemistry, creative thinking, education, PBL model, scaffolding, vitamin

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## 1. Introduction

### 1.1 Conceptual and Theoretical Framework

In improving human resources, an education that includes a learning and learning process is needed. Learning is the main activity in education that may be observed from student activities throughout learning, responses given by students in learning and mastering students' ideas (Hanafy, 2014; Pane & Dasopang, 2017; Rohmawati, 2015). Learning emerges from a reflective process through cognitive constructive action that can develop ideas, assume additional information critically and become higher ready to unravel problems based on the learning process (Black & Allen, 2018; Park, 2003; Pertel et al., 2020). This learning process is inseparable from media, methods, and deep learning outcomes so that they can remember concepts and are also able to train students within the skills required for their future desires (Setiawati, 2015; Wildan et al., 2019). The development of learning models in early stages of the research shows comparatively positive results, like the event of mixed learning which is expected to be useful in real life (Dwianto et al., 2017; Novitra, 2021). Therefore, the learning and teaching processes are needed in students' mastery of biochemistry courses.

Biochemistry is one of the science subjects with applications in various fields, such as medicine, agriculture, nutrition and industry (Anwar et al., 2017; Wildan et al., 2019). Biochemistry has become thus undefeated in explaining the method that nearly all units of the life sciences from biological science to medication are concerned with organic chemistry analysis (Zhou et al., 2015). Biochemistry is concerned with the atoms and molecules that make up the living world that can influence human behaviour connecting the natural and social sciences in new and meaningful ways (Cianci, 2019; Colver, 2015; Dustin et al., 2019). This study discusses vitamins where in vitamins are complex organic substances needed by the body that play a very important role in serving to the graceful absorption of nutrients and metabolic processes (Cresna et al., 2014; Hok et al., 2007). To achieve competence and skills in learning, appropriate learning strategies are needed. The strategy used in achieving these skills is the problem-based learning (PBL) model.

PBL may be a learning model that was first applied at the school of medical at McMaster University in Canada in 1970, which is community-oriented and problem-based (Moallem et al., 2019; Nickson, 2020). Problem based learning or PBL is one of the learning models designed. So students are able to solve issues. (Rusmansyah et al., 2019; Vandenhouten et al., 2017). This PBL model offers students the freedom to face the challenges of the world of education, like applying skills of communication, problem-solving skills, hots and independent learning (Chua et al., 2016; Shishigu et al., 2018; Tam, 2021). This problem-solving skill can be seen from how students investigate a problem and notice ways to resolve the given problem (Ediansyah, et al., 2019; Gillette, 2017). The PBL model aims for students to be able to develop students' creative thinking skills.

Creative-thinking is one of the higher order thinking skills that can help in solving problems and developing one's potential to the fullest. Creative thinking will offer confidence and improve educational accomplishment which will support the accomplishment of career success, also as success in a company (Huang et al., 2020; Sitorus & Masrayati, 2016). The importance of creativity skills is to make this component a target/competence of 21st-century educational achievements to produce authentic ideas (Ulger, 2016). This shows that students' creative thinking skills can develop well in line with problem-solving. As for this PBL model, its application will be more effective if assisted by a tutor, namely scaffolding which involves cognitive and metacognitive processes.

Scaffolding is assumed to be a promising technique that is employed in teaching and learning activities and to improve critical thinking skills for the last few decades (Gonulal & Loewen, 2018; Sotiriadou & Hill, 2015). Scaffolding is a process when a teacher, instructor or colleague helps students so that they can solve problems (Atsumbe et al., 2018; Hustedt, 2015; Mahan, 2020). Scaffolding is provided as temporary support by guiding and providing relevant resources as needed for problem-solving (Haruehansawasin & Kiattikomol, 2018). So it is complete that scaffolding will facilitate students through learning activities according to the direction of the teacher with technology or not using technology. This scaffolding can be adapted to the characteristics of learning faced by students, in order to enhance their creativity skills supported by the PBL model.

## 1.2 Related Research

In a previous research discussing about PBL, Ediansyah et al. (2019) concluded that the PBL model has an influence on the mastery of learning ideas. While the research conducted by Darmaji et al. (2019) stated that the problem-based student physics practicum ability was in the high category. The results of the research by Sugiharto et al. (2019) on this model are PBL models and collaborative activities are prospective efforts to be applied in classroom learning in biology education. Meanwhile, Palupi et al. (2020) concluded that, from the results of their research the PBL model can be used as a framework that can improve students' cognitive skills.

Furthermore, research results by Bilgin et al. (2009), showed that an approach of PBL helps students develop during learning. While in Atsumbe et al.'s (2018) study, a scaffolding approach is used to teach subjects, regardless of gender. The research conducted by Tarhan and Ayyildiz (2015) stated that PBL can be used as a very effective active learning approach for data formation, improvement of social skills and interest in biochemistry courses. Therefore, this study intends to complement previous research by developing a model of PBL that is integrated with scaffolding to improve students' creative thinking skills in biochemistry courses.

## 1.3 Aims and research questions of the study

According to the description that has been explained and several relevant research sources, this research focuses on a PBL model with scaffolding to improve students' creative thinking skills in biochemistry courses, especially on vitamins. The questions in this research are as follows:

1. How are the results of students' creative thinking skills using a PBL model with scaffolding in the biochemistry course on vitamins' material?
2. How are the results of students' creative thinking skills different using PBL models with scaffolding in the biochemistry course?.

## 2. Method and Material

### *2.1. Research design*

Research conducted using mixed method with an explanatory sequential design. The mixed method combines quantitative and qualitative research sequentially (Almeida, 2018; Tauscher & Laudien, 2018). Quantitative methods are used to obtain data about students' creative thinking skills in PBL with scaffolding through the provision of observation sheets and questions obtain through in-depth data about students' creativity skills in PBL with scaffolding conducted through interviews. This interview was conducted to strengthen the results of the quantitative research.

### *2.2. Participants*

The implementation time of this research was the even semester in the 2020/2021 academic year at one of the State Universities in Jambi Province, namely Jambi University. The population in this study were students of the chemistry education class 2018 which amounted to 113 students with details of the regular class A totalling 35 students (with 20 female students and 15 male students) and regular class B totalling 40 students (with 19 male students and 21 female students), while the regular class C consisteds of 38 students (with 22 male students and 16 female students) who were in the biochemistry courses. The class used is the experimental class, which is a class that uses learning with the PBL model integrated with scaffolding in the vitamin material. The researcher chose all classes as experimental classes because these three classes had biochemistry courses

### *2.3. Data collection tools*

Data were collected using creative thinking questionnaires, student observation questionnaires and interviews. The student observation questionnaires are used to measure students' creative thinking skills based on their psychomotor abilities. This instrument consists of 16 statements consisting of 5 aspects and 4 descriptor scores in stages. The research instruments adapt from the research performed by (Ratnaningsih, 2017) which explains the indicators of creative thinking in learning using Problem base learning. The lattice is explained by the following table

**Table 1.** Observation Sheet Grid for Creative Thinking Ability

| Aspect | Indicator |
|---|---|
| *Sensitivity* | Speed of asking questions |
| | Speed of responding to questions |
| | Speed to conclude the problem being discussed. |
| *Fluency* | Generate various ideas for problem solving |
| | Provide alternatives or input for doing something |
| | Work quicker and do additional in. |
| *Flexibility* | Generate problem solving ideas or answers to a variety of questions |
| | Can see a tangle from completely different views. |
| | Presenting an idea in a very totally different approach (with slate of presentation, style, expression or expression. |
| *Originality* | Provide new ideas in finding issues. |
| | Develop or enrich the ideas of others. |
| | Adding or describing a thought therefore on improving the standard of the concept. |
| *Elaborate* | Can verify the reality of an issue or the reality of a tangle finding set up. |
| | Can spark ideas to resolve a tangle and may implement it properly. |
| | Have a justifiable reason for reaching a decision. |
| | State the reason for the truth of the |

answer/statement

Furthermore, the creative thinking ability instrument is a questionnaire distributed to students to see their creative thinking skills in the cognitive realm. This creative thinking questionnaire is in the form of an essay consisting of five questions.

**Table 2.** Creative thinking questionnaire

| Aspects of creative thinking | Question indicator |
|---|---|
| *Sensitivity , fluency, flexibility, originality and elaboration* | Can prove correctly and in detail, by including five examples, the biological role of protein in facilitating the body's metabolic processes.<br>Skilled in thinking more than four precise and detailed ideas to prove, by including concrete examples that protein can be used to neutralise xenobiotic compounds that enter the body. |

The interview instrument is used to support the results of quantitative data that has been obtained, namely the results of observation sheets and critical thinking ability test instruments with eight questions.

**Table 3.** Interview test instrument grid

| Component | Sub Component |
|---|---|
| Student's responses to learning PBL integrated scaffolding | a. Student response to biochemistry learning.<br>b. Student attitudes that arise when applying pbl learning. |
| Measuring students' creative thinking skills in learning using PBL model integrated scaffolding in the biochemistry course | a. Ease of doing test questions in biochemistry learning with this learning model and strategy.<br>b. Students study in groups.<br>c. Students dare to ask questions to educators and friends. |

*2.4. Data collection process*

This research procedure starts from selecting the population and research sample, namely the 2018 class of chemistry education students which consists of three classes. The sampling technique was carried out using two techniques, namely total sampling and purposive sampling. The total sampling technique is a technique used in quantitative research samples by making all populations into samples (Edwan et al., 2017). This technique is carried out to provide an instrument of observation sheets and an instrument to test students' creative thinking skills. However, purposive sampling is used in qualitative research to identify phenomena (Palinkas et al., 2013). Purposive sampling technique was used for data collection using interview instruments.

After the sample is obtained, then the data are collected in the form of quantitative and qualitative data. This quantitative data was obtained from the observation sheet instrument and the creative thinking test instrument in the class being researched. After the data were collected, we proceed with collecting qualitative data by conducting interviews with students. This interview is important to carry out in order to strengthen the quantitative results or get more accurate results in this study.

### *2.5. Data Analysis*

Data analysis intends to obtain research results after the data are collected. Research data, namely observation sheets, test sheets and interview results are analysed according to research needs. The data obtained quantitatively, namely observation sheets and tests, were analysed using the Statistical Package for the Social Sciences software to find the mean value. The purpose of the mean value analysis is to determine the average score in the research class: the maximum value to see the highest score, and the maximum value to see the lowest value in each class (Odhier et al., 2019). Then we proceeded with testing the assumptions and hypotheses. Hypothesis testing is selected by performing the analysis of variance (ANOVA) and the advanced or *post-hoc* test. The ANOVA was administered to check the distinction within the results of the variables used in the three research classes (Masni et al., 2020; Zhu et al, 2019). The study results show that there was a distinction if the significance value was below 0.05. After the ANOVA test was carried out, the *post-hoc* test was then carried out which in this case was least significant difference (LSD). This LSD test is used to see which class has a difference in the average value based on the three research classes (Noviyanto et al., 2020).

## 3. Result

The research was conducted by collecting quantitative and qualitative data. The quantitative data obtained in the study were analysed to determine the mean, median, minimum and maximum values. The quantitative data were obtained from observation sheets and test sheets in the form of questions to determine students-critical thinking skills. The descriptive data obtained can be seen in Table 4 with very bad (VB), bad (B), good (G), very good (VG) categories.

Table 4. Descriptive results of student self-assessment for students' creative thinking skills

| Indicator | Class | Interval | Category | F | (%) | Mean |
|---|---|---|---|---|---|---|
| Sensitivity | A | 3.00–5.25 | VB | 0 | 0 | 9.77 |
| | | 5.26–7.50 | B | 0 | 0 | |
| | | 7.51– 9.75 | G | 16 | 45.7 | |
| | | 9.76–12.00 | VG | 19 | 54.3 | |
| | B | 3.00– 5.25 | VB | 0 | 0 | 9.75 |
| | | 5.26–7.50 | B | 0 | 0 | |
| | | 7.51– 9.75 | G | 22 | 55.0 | |
| | | 9.76–12.00 | VG | 18 | 45.0 | |
| | C | 3.00– 5.25 | VB | 0 | 0 | 10.82 |
| | | 5.26–7.50 | B | 0 | 0 | |
| | | 7.51– 9.75 | G | 0 | 0 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | 9.76–12.00 | VG | 38 | 100 | |
| Fluency | A | 3.00–5.25 | VB | 0 | 0 | 9.66 |
| | | 5.26–7.50 | B | 0 | 0 | |
| | | 7.51– 9.75 | G | 20 | 57.1 | |
| | | 9.76–12.00 | VG | 15 | 42.9 | |
| | B | 3.00– 5.25 | VB | 0 | 0 | 9.83 |
| | | 5.26–7.50 | B | 0 | 0 | |
| | | 7.51– 9.75 | G | 20 | 50.0 | |
| | | 9.76–12.00 | VG | 20 | 50.0 | |
| | C | 3.00– 5.25 | VB | 0 | 0 | 10.84 |
| | | 5.26–7.50 | B | 0 | 0 | |
| | | 7.51– 9.75 | G | 1 | 2.63 | |
| | | 9.76–12.00 | VG | 37 | 97.37 | |
| Flexibility | A | 3.00–5.25 | VB | 0 | 0 | 10.03 |
| | | 5.26–7.50 | B | 0 | 0 | |
| | | 7.51– 9.75 | G | 15 | 42.9 | |
| | | 9.76–12.00 | VG | 20 | 57.1 | |
| | B | 3.00– 5.25 | VB | 0 | 0 | 11.10 |
| | | 5.26–7.50 | B | 0 | 0 | |
| | | 7.51– 9.75 | G | 3 | 7.5 | |
| | | 9.76–12.00 | VG | 37 | 92.5 | |
| | C | 3.00– 5.25 | VB | 0 | 0 | 10.74 |
| | | 5.26–7.50 | B | 0 | 0 | |
| | | 7.51– 9.75 | G | 4 | 10.5 | |
| | | 9.76–12.00 | VG | 34 | 89.5 | |
| Originality | A | 3.00–5.25 | VB | 0 | 0 | 10.60 |
| | | 5.26–7.50 | B | 0 | 0 | |
| | | 7.51– 9.75 | G | 7 | 20 | |
| | | 9.76–12.00 | VG | 28 | 80 | |
| | B | 3.00– 5.25 | VB | 0 | 0 | 10.20 |
| | | 5.26–7.50 | B | 0 | 0 | |
| | | 7.51– 9.75 | G | 15 | 37.5 | |
| | | 9.76–12.00 | VG | 25 | 62.5 | |
| | C | 3.00– 5.25 | VB | 0 | 0 | 10.82 |
| | | 5.26–7.50 | B | 0 | 0 | |
| | | 7.51– 9.75 | G | 1 | 2.6 | |
| | | 9.76–12.00 | VG | 37 | 97.4 | |
| Elaborate | A | 3.00–5.25 | VB | 0 | 0 | 11.31 |
| | | 5.26–7.50 | B | 16 | 45.71 | |
| | | 7.51– 9.75 | G | 11 | 31.34 | |
| | | 9.76–12.00 | VG | 8 | 22.85 | |
| | B | 3.00– 5.25 | VB | 0 | 0 | 13.13 |

| | | | | | |
|---|---|---|---|---|---|
| | 5.26–7.50 | B | 6 | 15 | |
| | 7.51– 9.75 | G | 12 | 30.0 | |
| | 9.76–12.00 | VG | 22 | 55.0 | |
| C | 3.00– 5.25 | VB | 0 | 0 | 13.55 |
| | 5.26–7.50 | B | 0 | 0 | |
| | 7.51– 9.75 | G | 22 | 57.9 | |
| | 9.76–12.00 | VG | 16 | 42.1 | |

Table 4 shows the results of the descriptive observation sheets to assessing students skills in answering questions about creative thinking skills. This can be seen from the average C value for each indicator. In addition, descriptive results were also carried out to see students' creative thinking abilities based on the test questions given. These results can be seen in Table 5.

Table 5. Descriptive results of assessment of problem solving ability in students creative thinking

| Class | Interval | Category | Frequency | Percentage | Mean | Min | Max |
|---|---|---|---|---|---|---|---|
| A | 00.0–25.0 | VB | 0 | 0 | 68.29 | 39 | 89 |
| | 25.1–50.0 | B | 4 | 11.4 | | | |
| | 50.1–75.0 | G | 25 | 71.4 | | | |
| | 75.1–100.0 | VG | 6 | 17.1 | | | |
| B | 00.0–25.0 | VB | 0 | 0 | 68.18 | 45 | 95 |
| | 25.1–50.0 | B | 7 | 17.5 | | | |
| | 50.1–75.0 | G | 25 | 62.5 | | | |
| | 75.1–100.0 | VG | 8 | 20.0 | | | |
| C | 00.0–25.0 | VB | 0 | 0 | 78.21 | 49 | 100 |
| | 25.1–50.0 | B | 3 | 7.1 | | | |
| | 50.1–75.0 | G | 13 | 31.0 | | | |
| | 75.1–100.0 | VG | 22 | 52.4 | | | |

Table 5 shows the results of descriptive statistics on creative thinking skills which consist of several indicators. Based on the results in table 4, the information obtained that the highest score for cognitive creative thinking skills with the scaffolding integrated PBL model in chemistry education students is in class C. This can be seen from the average value of class C which looks superior to other classes, namely 78.21. In addition, the minimum value is 49 and the maximum value is 100. Furthermore, this study also conducted a prerequisite test or assumption test consisting of a normality test. The normality test was conducted to determine whether the data was normally distributed or not, and the homogeneity test was conducted to determine whether the data was homogeneous or not. The test results can be observed in Table 6.

Table 6. Assumption test results

| Instrument | Class | Normality test | | Homogeneity Test | |
|---|---|---|---|---|---|
| | | Sig | Distribute | Sig | Character |
| Observation sheet | Regular A | 0.083 | Normal | 0.473 | Homogeneous |
| | Regular B | 0.412 | Normal | | |
| | Regular C | 0.938 | Normal | | |
| About | Regular A | 0.087 | Normal | 0.242 | Homogeneous |

| | | | |
|---|---|---|---|
| | Regular B | 0.059 | Normal |
| | Regular C | 0.067 | Normal |

Table 6 shows the results of the assumption test consisting of a normality test and a homogeneity test. namely ANOVA test. The results of the ANOVA can be seen in Table 7.

Table 7. ANOVA test results

| **Variable** | **ANOVA** | **Sum of squares** | **df** | **Mean square** | ***F*** | **Sig** |
|---|---|---|---|---|---|---|
| Creative thinking question | Between Groups | 2514,218 | 2 | 1257.109 | 7.038 | 0.001 |
| | Within Groups | 19647.234 | 110 | 178,611 | | |
| | Total | 22161.451 | 112 | | | |

Table 7 shows the output results for the Anova. In the Anova , if the value of sig. is < 0.05, then it can be said that there is a difference between one variable and another, in this case. However, the significance value is 0.001 which means that there is a real or significant difference. After the ANOVA was carried out, further tests were carried out (post hoc) which in this study used the LSD test. The results of this test can be seen in Table 8.

Table 8. Post hoc test results (lsd)

| **Class (I)** | **Class (J)** | **Mean Difference (IJ)** | **Sig** |
|---|---|---|---|
| Regular A | Regular B | 0,111 | 0.972 |
| | Regular C | -9,925[a] | 0.002 |
| Regular B | Regular A | -0,111 | 0.972 |
| | Regular C | -10,036[a] | 0.001 |
| Regular C | Regular A | 9,925[a] | 0.002 |
| | Regular B | 10,036[a] | 0.001 |

Table 8 shows the results of further testing from the Anova. This test aims to see the differences that occur in the two classes, where there is a difference if the significance value is less than 0.05. The value of ([a]) in Table 8 is Predictors (constant from one variable to another). Based on Table 8, it can be seen that the smallest significance is between regular classes B and C, which means there is a significant difference in value, while in class A and B the significance is greater than 0.05, which means there is no significant difference.

After quantitative data were collected, qualitative data obtained from interviews were also collected. Interview results are used to support quantitative data analysis. The results of interviews with students regarding scaffolding-based learning in the vitamin biochemistry course with a PBL model showed good student responses which were marked by an increase in students critical thinking skills during learning. The results of the interview are as follows:

Q; Is it easier for students to understand biochemical material well using the PBL integrated scaffolding model?

*'I feel that when learning takes place, understanding biochemical material about vitamins becomes easier. The application of the scaffolding integrated PBL method is able to increase my creativity in doing learning'*

Q; What was your opinion during the learning with the scaffolding integrated PBL model on biochemical material?

*' I find it easy to understand the material, my motivation to learn also becomes more active. During the learning process, I feel that I can follow the lesson wel'*

Q; Is learning with the scaffolding integrated PBL model able to arouse your interest in studying biochemistry?

*'Yes, I became more interested in learning. By presenting problems related to the material, it made me interested in solving these problems'*

Q; Does learning with the PBL model help you in working on biochemistry questions?

*'Yes, because during the lesson I was given problems about phenomena related to biochemistry with vitamin material, it made me feel easier in solving problems about biochemistry.'*

Q; Do students become more active in learning by using scaffolding integrated PBL?

*'Yes, I am required to participate in active learning. Learning using the problem based learning method with integrated scaffolding makes students more active during learning. Either listening or giving opinions during the learning process.'*

Q; Does learning using the PBL model integrated with scaffolding students dare to reveal the answer?

*'Yes, during learning, students are given the same opportunity during learning. All students are given the opportunity to express their opinions by expressing answers or asking questions from other students, or from problems given by the lecturer'*

Q; In your opinion, can learning using the integrated PBL Scaffolding model be applied in group learning?

*'Yes, Problem-Based Learning can increase self-confidence and improve social life. During the learning process, students will work by discussing vitamin biochemistry learning materials with their friends, both in charge of explaining and asking questions.'*

Q; Can learning using the scaffolding-integrated PBL model increase cooperation between peers?

*'Yes, a sense of cooperation is created from scaffolding learning which makes students communicate, express opinions or ask questions to obtain solutions to problems related to biochemical material. This will certainly increase the sense of cooperation between students.'*

Q; Can learning using the scaffolding-integrated PBL model increase your persistence in studying biochemistry?

*'Yes, during learning takes place using Problem-Based Scaffolding Learning, students are required to think creatively in solving them. This will attract students' interest and persistence in studying biochemistry.'*

Q; Can learning using the scaffolding integrated PBL model make you more critical and creative in finding solutions to problems in studying biochemistry?

*'Yes, of course. Can learning using the scaffolding integrated PBL model make students more critical and creative in finding solutions to problems in studying biochemistry. This is because each student will be given problems related to biochemistry and students are required to solve them together with their friends. This will increase students' critical thinking and creative attitude during the learning process.'*.

## 4. Discussion

This study shows the results of students' creative thinking skills based on learning using the PBL model and integrated scaffolding. The creative thinking ability of students is one of the important things that must be considered by teachers. This creative thinking ability, especially in biochemistry courses at Jambi University, must be improved to keep up with the times and the education system. One way that can be used is a learning model that requires students to be directly involved in the process. The model chosen is the PBLmodel, because this model can be a solution to improve students' creative thinking skills based on the problems given.

Quantitative data were analysed using descriptive statistics based on five indicators, namely indicators of sensitivity, fluency, flexibility, originality and describing the three classes studied in the study. On the Sensitivity indicator, 54.3% (19 students) in class A had a very good category, 55.5% (22 students) in class B had a good category and 100% (38 students) in class C had a very good category. Based on these results, it is known that class C is more dominant than other classes in the this indicator. For the fluency indicator, 57.1% (20 students) in class A had a good category, while 50% (20 students) in class B had a very good score and 97.37% (37 students) in class C had a very good category. Based on these results, it is known that class C is more dominant than other classes on this indicator. On the flexibility indicator, 57.1% (20 students) in class A had a very good category, 92.5% (37 students) in class B had a good category and 89.5% (34 students) in class C had a very good category. Based on these results, it is known that class B is more dominant than other classes in the this indicator. In the originality indicator, 80% (25 students) in class A are in the very good category, while 62.5% (25 students) in class B are in the good category, and 97.4% (37 students) in class C are in the very good category. So it can be concluded that class C is more dominant than other classes on this indicator. In the elaborate indicator, 45.71% (16 students) in class A are in the bad category, while 55% (22 students) in class B are in the very good category, and 57.9% (22students) in class C are in the good category. So it can be concluded that class B is more dominant than other classes on this indicator. Based on these five indicators, it can be concluded that class C has the advantage of creative thinking skills.

This finding is supported by research conducted by Saye and Brush (2004) which argues that experiential learning in a problem-based environment that combines resources and technological support can improve students achievement. Based on research conducted by Belland et al (2009), further research is needed that examines the use of PBL with prioritised students with the same and different needs. One of the studies conducted by Haruehansawasin and Kiattikomol (2018), concluded that students with low levels of PBL learning achievement could benefit from more explicit guidance and encouragement to take a more participatory role in learning. The latest research conducted by Lin et al. (2020) which examined the development of scaffolding and teaching simulation tools resulted in the finding that students in the mind scaffolding group showed better learning effectiveness, which was significantly higher than students in the mind scaffolding group.

Zhou (2012) stated that this method can stimulate learning motivation and help students form their social identity as creative collaborators. This supports the statement of the research conducted by Adams et al (2010) that developing creative problem solving skills in students is very important, problem-solving is more than being able to solve routine or familiar problems; it's also about recognising strategies and processes. Meanwhile, research conducted by Saragih and Habeahan (2014) concludes that student learning outcomes taught through PBL are better because PBL can support productive and even innovative efforts to implement elements of creativity into regular classes.

Based on previous research, this research was conducted to complement the previous research. In previous research, only PBL was applied. The novelty in this research is developing PBL by integrating scaffolding in it and examining how PBL is related by integrating scaffolding with students creativity levels. This is seen from the distribution of the question questionnaire which is strengthened by interviews.

The researcher intends to develop a PBL model with scaffolding to improve students creative thinking skills in the first biochemistry course, especially vitamins. This PBL model with scaffolding aims to improve students creative thinking skills. Aspects of creative thinking that are measured include: sensitivity, fluency, flexibility, originality and elaboration. The results of the development are carried out in seven stages, namely:

1) Problem orientation: at this stage, the researcher will examine the problems that become the background of this research., matching the problems to be discussed classically which were formulated together in the group discussion task.
2) Group discussion: at this stage, group discussion is a scaffolding stage and strategy for problem solving. developing a problem solving strategy, include dividing tasks to each group member to prepare things needed in solving problems.
3) Classical discussion: at this stage, we find and collect information/data/facts for problem solving. Analyse/process information/data/facts obtained. Next, constructing it becomes an alternative problem solving. scaffolding is given by guiding/directing students in processing the information/data/facts obtained.
4) Scaffolding stage I: at this stage, students are given input or comments from educators as student motivation during learning. Each problem is given input from which conclusions will be drawn by the group in charge.
5) Elaboration: at this stage, students will be given new free problems with a minimum number of three problems that are tentative.
6) Classical discussion of elaboration: at this stage, analysing/processing information/data/facts are obtained. Furthermore, constructing becomes an alternative problem solving. Scaffolding is given by guiding/directing students in processing the information/data/facts obtained with the provision that one problem is given three responses by the group of questionnaires.
7) Scaffolding stage II: is the last stage of learning in which the lecturer will finalise the problem solving collected during the learning process. Scaffolding is provided on an ongoing basis (series scaffolding) and as needed (flexible) in the form of guidance, direction, reinforcement, motivation and facilitation.

Each stage allows the formation of creative thinking aspects, through activities: analyzing and evaluating information, synthesising many ideas and training insights on the selection of new ideas, as well as elaborating proble-solving ideas.

The implications of this research include suggestions for educators, both lecturers and teachers, which can be used as a guide in designing learning. Learning using the scaffolding integrated PBL model does not only apply to biochemistry material, but can be used in other materials such as chemistry, biology, physics and other studies. . This research needs to be carried out so that learning can run to be more innovative and well organised. Furthermore, this research can also be used as a reference for further researchers in conducting further research and can be a source of study literature that can be used as additional material in conducting research.

This research is limited to knowing students' creative thinking skills by using a PBL model that is integrated with scaffolding. It is hoped that further researchers can conduct research in a wider field such as by developing other learning models, as needed to improve students' cognitive aspects by using other learning models that are integrated with scaffolding. In addition, further researchers can also develop this research by adding more complex variables such as critical thinking skills in other biochemistry materials or in subjects that have the same characteristics as this course such as biology, chemistry, physics, or other fields as needed.

## 5. Conclusion

Based on the research that has been conducted, it can be concluded that, the student learning process with a PBL integrated with scaffolding can improve students creative thinking skills. This can be seen from the cognitive and non-cognitive results of students. Based on non-cognitive results, namely observations of students self-assessment in solving problems, students have skills that are categorised as good on each assessment indicator. As for cognitive outcomes, students' creative thinking abilities are known to increase by using this learning model. However, in the results of the study, it was found that one of the classes with the most superior grades was a regular C class student. This can be seen in the results of the ANOVA test, where the significance value is less than 0.05, which indicates that there are significant differences in creative thinking abilities in each class. Furthermore, in the post hoc test using LSD, it is known that the classes that show significant differences in creative thinking abilities are between class C and class A, as well as between class C and class B.

## 6. Recommendation

As for the recommendation from the research that has been carried out by the researcher, it is hoped that the reader can analyse more deeply about the ways to increase creativity in learning. this can be supported by other research studies that collaborates approaches and methods in learning.

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