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Creative Thinking Skills on the Response to Problem- Based Learning in Biochemistry Courses

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ABSTRAK

Kemampuan berpikir kreatif mahasiswa diperlukan dalam perguruan tinggi sekarang ini khususnya dalam mata kuliah biokimia dengan menerapkan pembelajaran PBL. Tujuan dari dilakukannya penelitian ini adalah untuk menganalisis hubungan pembelajaran PBL terhadap kemampuan berpikir kreatif mahasiswa dengan menerapkan pembelajaran PBL dalam pembelajaran biokimia. Metode yang digunakan dalam penelitian ini adalah mix method dengan menggunakan model sequential explanatory. Sampel yang digunakan dalam penelitian ini adalah 52 mahasiswa. Metode yang digunakan dalam mengumpulkan data yaitu kuesioner, wawancara, dan tes. Instrumen pengumpulan data yang digunakan dalam penelitian ini adalah lembar esai, dan angket. Analisis data yang digunakan untuk data kuantitatif adalah statistik deskriptif dan uji korelasi. Data kualitatid di analsis menggunakan miles & Huberman. Hasil penelitian yaitu dari data yang telah diperoleh melalui uji coba korelasi adalah terdapat hubungan antara kedua variabel tersebut. Selain itu dari hasil wawancara dapat diambil kesimpulan bahwa model pembelajaran PBL berpengaruh terhadap keterampilan berpikir kreatif siswa. Data tersebut diperkuat dengan hasil wawancara bahwa siswa merasa bahwa kemampuan berpikir kreatifnya meningkat dengan pembelajaran PBL. Disimpulkan pembelajaran PBL memiliki hubungan dengan kemampuan berpikir kreatif mahasiswa khususnya dalam mata kuliah biokimia.

ABSTRACT

Students' creative thinking abilities are needed in higher education today, especially in biochemistry courses, by applying PBL learning. This research aimed to analyze the relationship between PBL learning and students' creative thinking abilities by applying PBL learning in biochemistry learning. The method used in this study is the mixed method using a sequential explanatory model. The sample used in this study was 52 students. The methods used in collecting data are questionnaires, interviews, and tests. The data collection instruments used in this study were essay sheets and questionnaires. Data analysis used for quantitative data is descriptive statistics and correlation tests. Qualitative data is analyzed using Miles & Huberman. The results of the research, namely from the data that has been obtained through correlation trials, show that there is a relationship between the two variables. In addition, from the interview results, the PBL learning model influences students' creative thinking skills. The data is reinforced by the results of interviews that students feel that their creative thinking skills increase with PBL learning. It was concluded that PBL learning relates to students' creative thinking abilities, especially in biochemistry courses.

1. INTRODUCTION

Biochemistry has a very wide range of materials, including enzymes and coenzymes (Mutlu, 2018; Seruni et al., 2019). Biochemistry is a course that studies the structure and function of cellular components, such as proteins, carbohydrates, lipids, nucleic acids, and other biomolecules. The biochemistry course contains material on the chemistry of enzyme-mediated reactions and the properties of proteins (Isnayni & Hermansyah, 2020; Kurniawati & Jailani, 2020; Muliawati & Pathoni, 2020).Students are expected to be able to know and understand the concept of biochemistry itself. Skills are also very much needed in this biochemistry course, especially creative thinking skills (Diawati et al., 2017; Silitonga, 2018; Wahyudi, 2019). One of the goals of university education is to provide higher order thinking skills, such as creative thinking. The ability to think creatively has a tendency to train students to

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issue ideas that arise or express themselves in the learning process (Astalini et al., 2022; Wahyuni & Kurniawan, 2018). Creative thinking skills are very important that must be possessed by students, because creative thinking skills are one of the learning competencies in the 21st century today (Ma et al., 2021; Mulyono, 2018; Trnova, 2014).The goals of education in the 21st century must refer to the sustainable development goals (SDGs) (Omilani et al., 2019; Jumrodah et al., 2021). So from this explanation it states that students' creative thinking abilities are needed in state universities, especially in the 21st century. The ability to think creatively is the ability to analyze something based on available data or information but also generate new concepts that are much more perfect and determine alternatives with various ideas that can be used to solve the problem (Siregar et al., 2020; Toheri et al., 2020; Yayuk et al., 2020). The ability to think creatively is an important ability for students to have so that students can solve problems faced in a world that is constantly changing (Warner & Kaur, 2021; Andiyana, 2018). In solving a problem, when applyin creative thinking, will produce many useful ideas in finding solutions (Lince, 2016; Noviyana, 2017; Ritter & Mostert, 2017). It turns out that creative thinking skills are also not enough without an effective learning approach for biochemistry education students.

The approach that is usually used in learning so that learning in biochemistry courses is more effective is Problem-based learning (PBL) (Kwon et al., 2018; Silitonga, 2018; Siregar et al., 2020). Problem-based learning (PBL) is a student-centered approach in a collaborative environment that produces solutions to solve real-life problems using their knowledge and new information obtained by surveying various information (Chis et al., 2018; Tarhan & Ayyildiz, 2015). PBL is also able to improve science process skills and student learning outcomes (Nur et al., 2016; Permatasari et al., 2019; Serevina et al, 2018). Therefore, Problem-based learning is very useful for Biochemistry courses. Biochemistry in cell biology through the earthquake in New Zealand Research conducted by (Collings et al., 2019) . The research focused on Student Views on Problem-Based Learning Applications in Biochemistry Courses (Tarhan & Ayyildiz, 2015). The difficulty of undergraduate biochemistry students with a topic requiring skills: the use of skills support sites to study biochemistry the research was conducted by (Watters et al., 2020). The application of problem based learning in developing students' creative thinking skills (Abdurrozak & Jayadinata, 2016; Rohana & Wahyudin, 2017).

From these several studies, it can be identified that the research that has been carried out focuses on biochemistry which includes cell biology and earthquakes, so that biochemical research is on enzymes and coenzymes. In addition, the research above also focuses on the application of problem-based learning to creative thinking and only to learning mathematics. Research on the correlation of problem-based learning and creative thinking skills on enzymes and coenzymes in Biochemistry courses has never been done. So that in this study will focus on that research. The implication of this research is that it can provide knowledge for readers and for teachers how much influence problem-based learning has on students' creative thinking abilities, especially in biochemistry courses. So that later problem-based learning can be used as a reference in learning that improves students' creative thinking skills. In addition, for researchers, research can be used as a reference in conducting other research that has the same theme, so that knowledge can be wider. Based on the explanation above, the purpose of this study was to determine the effect of problem-based learning and creative thinking skills on enzymes and coenzymes in Biochemistry courses.

2. METHOD

The type of research used in this study is a mixed method with a sequential explanatory research design. Mix method research is a research method that combines qualitative research methods and quantitative research methods at the same time (Mustaqim, 2016). The research approach is the mixed methods sequential explanatory method, namely the first stage of the research uses quantitative methods, namely collecting data and qualitative analysis and in the second stage carrying out qualitative data collection and analysis (Pane, 2015). The sample used in this study were chemistry students. The sampling technique used was purposive sampling technique. The purposive sampling technique is a sample determination technique with certain considerations (Sugiyono, 2016). So that the samples taken in this study were students who had studied biochemistry and the samples obtained were 52 students. The data collection instruments used in this study were essay sheets, student response questionnaires and interviews. The essay questions consist of 10 ports and the response questionnaire consists of 20 ports covering three aspects. The essay question grid in Table 1.

From Table 1 above, there are 10 statements consisting of 3 aspects. Which consists of 3 statements for C4, 2 statements for C5, and 5 statements for C6. Then to see the student response questionnaire grid, showed in Table 2.

Table 1. Creative Thinking Skills Grid on Enzyme and Coenzyme Material

Aspect	Question Level			Number of Questions
	C4	C5	C6	
Smooth Thinking	1		2, 10	3
Think Flexible		4	3	2
Thinking Originality	5		6	2
Decomposition	7	8	9	3

Table 2. Student Response Grid to Problem-Based Learning

No.	Aspect	Question Number	Number of Questions
1.	Studnt attitudes towards the learning process	1, 2, 3, 4, 5, 19, 20	7
2.	Student interest/interest in learning	6, 7, 8, 9, 10, 17, 18	7
3.	Student clarity on the learning process	11, 12, 13, 14, 15, 16	6

Based on Table 2, it can be seen that from the 3 aspects, there are 20 statements. From each aspect it has 7 statements for student attitudes towards the learning process, 7 statements for student interest/interest in learning, and 6 statements for student clarity on the learning process. Interviews with students were also conducted to corroborate the quantitative results obtained from essay questions and student responses. Interview transcripts related to problem-based learning on creative thinking skills in biochemistry courses, especially enzymes and coenzymes showed in Table 3.

Table 3. List of Questions for Students

No.	Question	Number of Question
1.	How do you fell when you take part in learning with a problem based learning model in biochemistry courses?	1
2.	Can the application of this problem based learning model increase your interest in leraning?	2
3.	Can the application of a problem based learning model train your creative thingking skills?	3
4.	In your opinion can the application of a problem based learning model improve your creative thingking skills?	4

Based on Table 3, there are 4 questions regarding learning using problem based learning and students' creative thinking in biochemistry courses. This list of questions is given to students who can later strengthen the quantitative results. Then to see the categorization interval of Creative Thinking Ability and Student Response to Problem-based learning in the Biochemistry course showed in Table 4.

Table 4. Interval Category of Critical Thinking Ability to Problem-Based Learning

Interval	Category
0.0- 25.0	Not good
25.1 – 50.0	Pretty good
50.1 – 75.0	Good
75.1 – 100.0	Very good

The interval scale used in the ability to think creatively towards problem based learning has 4 categories. The four categories have different intervals according to the existing categories. The student response interval scale for problem-based learning showed in Table 5. From Table 5. there are 4 interval scales used to assess student responses to problem based learning with each interval. Data analysis used in quantitative research used correlation tests and descriptive statistics while data analysis used for interview data was Miles & Huberman. Correlation test was conducted to determine the relationship between creative thinking and problem based learning. However, before carrying out the correlation test, the data obtained must be tested for linearity and normality first. Descriptive statistics are used to see the advantages of creative thinking in learning using problem based learning.

Table 5. Category Interval of Student Response to the PBL Model

Interval	Category
19.0 – 38.0	Not good
38.1 – 57.0	Pretty good
57.1 – 76.0	Good
76.1 – 95.0	Very good

Activities in data analysis using descriptive statistics are carried out by finding the average value (mean), median, minimum value and maximum value in order to obtain an overview of the characteristics of the data (Darmaji et al., 2020; Putri, 2021). Meanwhile, Miles & Huberman was used to analyze chemistry student interview data. the activities carried out in Miles and Huberman's analysis are data reduction, data display, and verification of conclusions (Huda et al., 2020; Rivani et al., 2022). The stages in conducting this research showed in Figure 1.

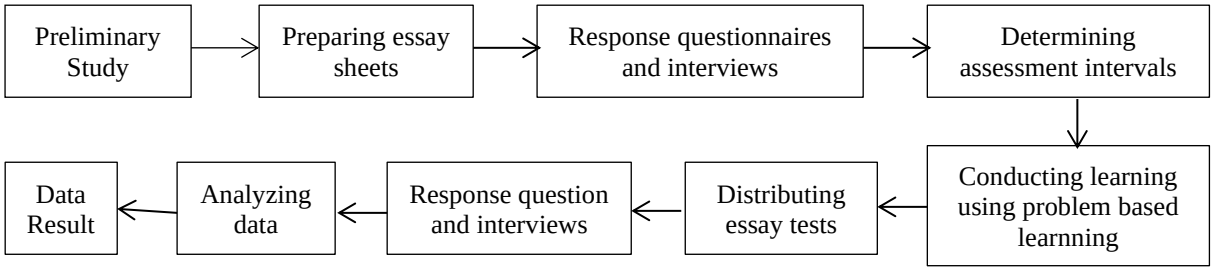

Figure 2. Research Stages

3. RESULT AND DISCUSSION

Result

To describe the ability to think creatively and students' responses to the PBL learning model, the researcher conducted a descriptive statistical test. The statistical test results in Table 6.

Table 6. Description of Student Thinking Ability in Biochemistry Course

Interval	Category	F	%	Mean	Median	Mode
0.0 – 25.0	Not good	0	0.00%	63.27	60.00	57
25.1 – 50.0	Pretty good	7	13.50%			
50.1 – 75.0	Good	26	50.00%			
75.1 – 100.0	Very good	19	36.50%			

From Table 6. it was found that the students' creative thinking ability obtained a percentage value of 50% in the good category. Then the mean value is 63.27, the median is 60.00 and the mode is 57. A descriptive statistical test is then performed on the student's response data to PBL, the results of which are presented in Table 7.

Table 7. Description of Student Response to the PBL Learning Model

Interval	Category	F	%	Mean	Median	Mode
19.0 – 38.0	Not good	0	0.00%	68.50	67.00	67
38.1 – 57.0	Pretty good	4	7.70%			
57.1 – 76.0	Good	31	59.60%			
76.1 – 95.0	Very good	17	32.70%			

Based on Table 7, it shows that the students' responses to the PBL learning model obtained a percentage value of 59.60% in the good category, with a mean value of 68.50, a median value of 67.00 and a mode of 67. Then, a normality test was carried out on the variable ability to think creatively and students' responses to the model PBL in Biochemistry courses, with the results presented in Table 8.

Table 8. Normality Test of Creative Thinking Ability Variables and Student Responses to Biochemistry Courses

Variable	Kolmogorov-Smirnov	
	Sig.	Normal distribution
Creative thinking ability	0.200	Normal
Student response to PBL	0.200	Normal

From Table 8. the results of the normality test for creative thinking skills and students' responses to PBL with a sig. 0.200 and 0.200 which means the significance value is greater than 0.05 so that the data can be said to be normal. To see the linearity of the data, a linearity test was carried out, the results of which in Table 9.

Table 9. Linearity Test of Creative Thinking Skills and Student Responses to PBL Biochemistry Courses

Variable	N	Sig. (2-tailed)
Student response to problem-based learning	52	.021
Creative thinking ability	52	.000

In Table 9 it can be seen that the significance values of the linearity of student response questionnaires and tests of creative thinking skills are 0.021 and 0.000, where the sig. < 0.05 means that the data has a linear relationship. Then a correlation test was carried out to see the relationship between student responses to problem based learning models and creative thinking skills, the results of which are presented in Table 10.

Table 10. Pearson Correlation Test of Students' Responses to Problem-Based Learning Models with Creative Thinking Abilities

Variable	N	Sig. (2-tailed)
Student response to problem-based learning	52	0.000
Creative thinking ability	52	0.000

From Table 10. it is known that the sig. 0.000 < 0.05, meaning that there is a significant relationship between students' responses to problem-based learning models with the ability to think creatively on enzymes and coenzymes. After analyzing the quantitative data from the results of the distribution of essay tests and student response questionnaires. Furthermore, researchers analyzed qualitative data in the form of interviews with students. The transcripts of data from interviews with two students in Table 11.

Table 11. Interview Transcripts About Student Responses to Problem-Based Learning and Creative Thinking Abilities

No.	Question	Answer
1.	How do you feel when you take part in learning with a problem-based learning model in biochemistry courses?	"I am very happy, and learning becomes more interesting." "I like it, because by applying this learning model it becomes easier for me to solve problems."
2.	Can the application of this problem-based learning model increase your interest in learning?	"Yes of course." "Yes, I am more enthusiastic in studying."
3.	Can the application of a problem-based learning model train your creative thinking skills?	"Yes, I can find more ideas in solving problems." "Yes, I can think flexibly and convey new ideas that I have."
4.	In your opinion, can the application of a problem-based learning model improve your creative thinking skills?	"I think I can." "Of course, I can."

From the results of student answers it is known that students are very enthusiastic, happy, and interested in participating in learning with a problem-based learning model. In addition, students can

train and improve their creative thinking skills through the application of this problem-based learning model.

Discussion

Based on the results of descriptive statistical tests related to student responses to problem based learning (PBL) learning models, it is known that dominant students have a good response to this learning model so that they can improve students' creative thinking abilities in learning enzymes and co-enzymes in Biochemistry courses. Then, from the results of descriptive statistical tests on students' creative thinking abilities, it is known that students have good creative thinking abilities. Thus, students are able to develop useful ideas to create new things and a good and conducive learning atmosphere, and can solve existing problems. Then the normality test results were obtained which showed that student response data to problem-based learning models and students' creative thinking abilities were normally distributed. Followed by a linearity test with results showing that student response data to problem-based learning models and students' creative thinking abilities stated that there was a linear relationship. Then a hypothesis test was carried out, namely the Pearson correlation test, the results show that there is a relationship between the PBL learning model and students' creative thinking abilities. Problem-based learning can help students solve problems by communicating with one another so that students' creative thinking skills can improve over time. From the results of the interviews it is known that students are very enthusiastic, happy, and interested in participating in learning with a problem-based learning model. In addition, students can train and improve their creative thinking skills through the application of this problem-based learning model.

The novelty of this study is to analyze the relationship between students' responses to problem-based learning and creative thinking skills. Where in previous studies had never analyzed the relationship, and only analyzed the influence and differences between one of the variables in this study. In addition, the research subjects used are also different. Where in several studies using research subjects high school students with a different number. Students' creative thinking abilities can be improved by applying a problem-based learning model. This learning model can provide authentic learning experiences for students that integrate learning in real life, everyday life which can stimulate the growth of students' creative thinking abilities (Giriyanti, 2019; Puriasih & Trisna, 2022; Simbolon & Koeswanti, 2020).

The problem-based learning model can influence students' higher-order thinking skills such as critical and creative thinking (Amin et al., 2020; Aufa et al., 2021; Ismail et al., 2018). If this problem-based learning model is not implemented, students will find it difficult to train critical and creative thinking to solve a problem, so that it can also affect poor learning outcomes. In addition, students who do not have the ability to think creatively will have an impact on their learning, where students only accept it material delivered by the teacher, without searching for and finding concepts from the material provided, and students will find it difficult to learn the material, so that it can also have an impact on unsatisfactory learning outcomes (Choi et al., 2014; Hadi et al., 2022; Kumar & Refaei, 2017; Saputra et al., 2019). The implication of this research is suggestions for educators as a guide in designing learning. Learning using this problem-based learning model does not only apply to biochemistry material, but can also be used in other materials such as physics, chemistry, biology, mathematics and other studies. This research needs to be done to create innovative, conducive, and effective learning. In addition, this research can be used as a reference and reference for further research. This research is limited to knowing the relationship of problem-based learning with students' creative thinking abilities. It is hoped that future researchers can conduct research using other learning models, other materials and courses, and other variables as needed to improve students' cognitive aspects.

4. CONCLUSION

Based on the research that has been done, it can be concluded that there is a significant relationship between students' responses to problem-based learning and the ability to think creatively. A good student response will have an impact on good creative thinking skills as well. With the implementation of this learning model, it can create learning that is innovative, conducive, and effective. It is hoped that further research can add to student learning outcomes related to creative thinking abilities and student responses to PBL biochemistry courses with different materials.

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