

Correlation analysis of biotechnology theme project-based learning with students creative thinking skills at the junior high school

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Article Information	Abstract
Keyword: Correlation analysis; Project-based learning; Creative thinking skills; Biotechnology Kata Kunci: Analisis korelasi; Pembelajaran berbasis proyek; Keterampilan berpikir kreatif; Bioteknologi History: Received : 20/07/2023 Accepted : 10/10/2023	Learning is a core element in education, especially in achieving the goals of educational institutions. Through science learning, students can improve their self-esteem and understand their natural surroundings. Science learning involves scientific methods to develop students' thinking patterns. Project-based learning aims to develop conceptual understanding through investigating significant problems and producing products. The learning model must also be tested for its influence on students' creative thinking abilities, including biotechnology material. This study aims to determine the significant correlation between project-based learning and students' creative thinking skills. This study uses a quantitative approach. The statistical test uses the Pearson product-moment correlation analysis technique. The data showed a positive relationship between biotechnology-themed project-based learning and students' creative thinking skills. Project-based learning can help students improve creative thinking skills and be more contextual or meaningful so students can easily remember them. Abstrak Belajar adalah unsur inti dalam pendidikan, khususnya dalam mencapai tujuan lembaga pendidikan. Melalui pembelajaran IPA, peserta didik dapat meningkatkan kualitas diri dan memahami alam sekitar. Pembelajaran IPA melibatkan metode ilmiah untuk mengembangkan pola pikir peserta didik. Pembelajaran berbasis proyek bertujuan untuk mengembangkan pemahaman konseptual melalui penyelidikan masalah yang signifikan dan menghasilkan produk. Model pembelajaran juga perlu diuji pengaruhnya terhadap kemampuan berpikir kreatif peserta didik, salah satunya pada materi bioteknologi. Penelitian ini bertujuan untuk mengetahui hubungan yang signifikan antara pembelajaran berbasis proyek dengan keterampilan berpikir kreatif peserta didik. Penelitian ini menggunakan pendekatan kuantitatif. Pengujian statistik menggunakan teknik analisis korelasi <i>product moment Pearson</i>. Berdasarkan hasil data tersebut, diperoleh hubungan yang positif antara pembelajaran berbasis proyek bertema bioteknologi dengan keterampilan berpikir kreatif peserta didik. Pembelajaran berbasis proyek dapat membantu peserta didik untuk meningkatkan keterampilan berpikir kreatif dan lebih kontekstual atau lebih bermakna sehingga dapat dengan mudah diingat oleh peserta didik.

A. Introduction

In the 21st century, science is developing quickly, requiring individuals to become qualified human resources. Quality human resources have the characteristics of managing, using, and developing thinking power, one of which is creative thinking (MZ et al., 2021). Learning in the 21st century currently involves activeness, skills, motivation, critical thinking, and creative thinking, which are still developing. That project-based learning is an ideal learning model for achieving the goals of 21st-century education because it involves the principles of critical thinking, creative thinking, communication, collaboration, creativity, and motivation. Project-based learning is an effective way to develop skills needed in the 21st century by emphasizing creative thinking processes, problem-solving, interpersonal communication, information and media literacy, collaboration, leadership and teamwork, innovation, and creativity (Widyantini et al., 2022).

In the 21st century, students must have critical thinking skills, communication, collaboration, creativity, and innovation. Models, approaches, and appropriate learning strategies are needed to improve these skills. Several learning models are required to achieve these learning objectives. One learning model that can realize these goals is the Project Based Learning model. PjBL is a learning model that puts forward a project to produce a product (Mere, 2023). Based on the PISA results, summarize the average scores and results of OECD countries' scientific proficiency ranking (IPA). Indonesian students had an average science score of 396 in 2018. According to Lestari & Ilhami (2022), Indonesia's 2018 PISA score is 74th out of 79 participating countries. Of course, the results above show the need for learning to improve creative thinking skills in 21st-century learning.

Project-based learning can train creative thinking skills. With the ability to think creatively, students can improve their ability to develop fine motor skills (Sabaryati et al., 2022). According to Firdaus et al. (2022), to foster creative thinking skills, one way that can be done is to use the Project-based learning model. The application of the project-based learning model in science learning can provide stimulus to students because the project-based learning model is a learning model that involves constructivism and can improve creative thinking skills by involving students in a project to develop their skills. In line with this, according to Ningsih et al. (2021) students who can think creatively can find solutions in new ways. This ability is one of the

goals that must be achieved in science learning at school. In this regard, teachers can provide activity-oriented project assignments that support understanding concepts, principles, and procedures in everyday life.

Learning creativity is one of the efforts to foster independent learning. Learning creativity is an attitude in which a person can generate new ideas and develop them into an experiment that other students rarely find. Someone with a creative attitude is likelier to be independent (Sulistiyowati & Roshayanti, 2022). Students must develop creative thinking skills to become superior individuals who can compete and face problems related to the real world (Barokah et al., 2021). Creativity itself is a very important part of education, as one of the goals of education is to give birth to a creative generation (Taupik et al., 2023). Mastery of creative thinking skills in solving problems and creating new ideas is closely associated with learning science. In essence, it is a product, process, and implications used to study, discover, and build an object of study.

Biology is learning that is related to how to find out and systematically understand nature. Hence, learning biology is mastering a collection of knowledge in the form of facts and concepts and a process of discovery so that students can think critically and creatively. The ability to think creatively is an important ability for someone. Still, students' knowledge at school has not shown encouraging results, especially in creative thinking. The learning model causes a low ability to think creatively, which is still conventional, teacher-centered, and has not provided direct experience to students (Widyantini et al., 2022).

Until now, students' creative thinking skills have not received more attention in the science learning process. Research found low levels of creative thinking skills (Nurfa & Nana, 2020), showing that 74% of students cannot apply the physics material studied to solve a problem. 72% of students cannot use the physics material they have learned to a product or work. According to Santoso & Wulandari (2020), the science learning process tends to be monotonous, causing student learning outcomes to no longer significantly influence their thinking abilities. Low creative thinking skills result in students having difficulty solving current and future problems in the learning process.

In line with research conducted by Aisyah et al. (2022), Asymp Sig. results were obtained (2-tailed) of 0.000, it can be seen that Asymp Sig. (2-tailed) < 0.05, so H_0 is rejected, and H_1 is accepted, meaning that the project-based Discovery Learning

learning model influences students' creative thinking abilities. In line with this research, Wulandari et al. (2019) found that students using the PjBL model had better creativity than those taught using the STAD-type cooperative model. The average posttest score for the PjBL model group was 88.67, while the STAD-type cooperative model was 33.86.

In line with this, improving creative thinking skills is also carried out in research Nurfa & Nana (2020); it was found that the analysis of the observation sheet on students' creative thinking abilities showed that in the experimental class, the results were 77.1% in the good category and in the control class it was 73.2% in the sufficient category. The good category results in the experimental class prove that using the 21st Century Skills integrated Project Learning model can influence the creative thinking abilities of high school physics students. Additionally, in research Permana et al. (2023) the Project Learning model has a positive influence on the creative thinking abilities and science learning outcomes of fifth-grade elementary school students. This research was limited to testing the ability to think creatively and fluently.

Thus, the researcher is interested in examining the relationship or correlation of project-based learning with the creative thinking skills of biotechnology-themed students at the junior high school level.

This is reinforced by the results of observations at PGRI Kesilir Middle School, that students are happier if learning is carried out with activities so that students can also develop creative thinking abilities. Therefore, there is a need for learning innovation, where this innovation can stimulate students' creative thinking abilities, one of which is by using project-based learning. According to Sabaryati et al. (2022), students can be actively involved in completing projects independently or collaborating in teams and can integrate their knowledge in solving real and practical problems.

B. Material and Method

The approach used in this research is quantitative. The research was conducted at Kesilir PGRI Middle School, Wuluhan District, Jember Regency. The population in this study was students of class IX at SMP PGRI Kesilir.

The instrument in this research is a creative thinking project task. All instruments were analyzed first using the normality test and correlation test. Data was tested and analyzed using the IBM SPSS Statistics 26 application.

The analysis used in this research is correlation test analysis. Data analysis used IBM SPSS 25 software. The correlation test used was the Pearson product-moment correlation test based on the results of normal distribution data and linearity tests.

The correlation test determines the relationship's strength or closeness by looking at the coefficient value according to Table 1 by Sugiyono (2019).

Table 1 Interval Correlation Level Coefficient

Coefficient Intervals	Relationship Level
0,00 – 0,199	Very low
0,20 – 0,399	Low
0,40 – 0,599	Medium
0,60 – 0,799	Strong
0,80 – 1,000	Very strong

C. Results and Discussion

The 21st Century competencies included in the curriculum consist of six terms, which are abbreviated as the 6Cs of 21st Century Education. 6C stands for Critical Thinking, Creativity, Collaboration, Communication, Computational and Compassion.

Creative thinking encourages students to creative thinking based on the Guilford 1967 model. Four aspects of creative thinking: 1) Fluency in thinking, helping students find answers as quickly as possible; 2) Flexibility, allowing students to create ideas to change the form of an attractive presentation from different brochures; 3) Originality means, the ability to create ideas, students design presentations using appropriate devices or technology; and 4) Elaboration, developing thinking skills to expand, add or create new ideas from evaluating answers according to predetermined criteria (Kwangmuang et al., 2021).

The main characteristics of project-based learning are authentic scientific problems, student involvement in investigations or active design, product development as a result of projects, collaboration activities, and the use of technology (Barak & Yuan, 2021). In project-based learning, the end product is the task's main focus, and the project's completion primarily requires the application of previously acquired knowledge. Project-based assessment requires students in groups to carry out investigative activities within a specified time (Gomez-del Rio & Rodriguez, 2022). The basis of project-based learning is that students should not learn abstract definitions but must learn by completing complex projects (Maros et al., 2021).



Figure 1
Student activities in making ice cream biotechnology



Figure 2
Students' work in making rotating ice cream biotechnology

Figure 1 shows the activities of students in making biotechnology products after determining their tools and materials. Students independently determine the tools and materials used after analyzing existing problems in the environment and literature on the use of biotechnology. One of the important ingredients in the manufacture of products is salt. Mixing the salt into the ice cubes causes some ice cubes to melt and form brine. The reaction of salt and ice cubes will cause a decrease in temperature. This includes exothermic reactions, namely reactions that release heat or energy.

Based on Figure 2, students are indicators of flexibility. Students can generate ideas, answers, or questions that vary. In determining tools and materials, students can provide various answers and questions. The indicator of originality is the ability of students to create new and unique expressions. Students can think of ways to express a term or explain something related to biotechnology material. Elaboration is the ability of students to respond to questions enthusiastically, actively, and enthusiastically in solving problems, and this can be seen when students answer a series of processes for making rotating ice cream using salt in the reaction process. Fluency is students' creativity in sparking many ideas and answers and solving problems or questions. This is evidenced by

students' answers in making various ideas or ideas about the ingredients used, such as flavor variations in making products.

The learning objectives of biotechnology material, according to Sulistyowati & Roshayanti (2022), are to provide knowledge to understand the meaning of biotechnology, the basic principles of biotechnology, distinguish conventional and modern biotechnology and be able to explain processes and their benefits in life. In addition, teaching biotechnology is expected to increase students' awareness of the development of technological and applied science, the use of living things, and the preservation of the environment and Indonesia's natural resources. Based on experience, the success of teaching depends on students' level of independence and creativity.

Figure 2 shows one of the results of a student project that succeeded in making a rotating ice cream biotechnology product using tools and materials that are easy to find in everyday life. Based on research findings, project-based learning provides optimal benefits for developing students' creativity. According to Chen et al. (2022), students can more easily understand the concept of creativity and can design project sketches. This finding aligns with research by Mursid et al. (2022), which shows an interaction between the influence of project-based learning models and creative thinking skills on learning outcomes. This indicates that working on a project in a team encourages students to get new ideas by observing intensively and asking questions.

Through learning with the PjBL model or project-based learning, students have new experiences in education. The learning carried out requires students to be more active in carrying out learning. So that learning can be done in a student-centered manner, which makes it easier to understand the concept of learning science (Zuhaida & Muhtasyiroh, 2022).

Backed by research Fatma (2021), students' creativity is very visible in learning biotechnology through STEAM-based PJBL in making steamed buns, as well as the literature review process when answering questions on LKPD. This shows that the PJBL model or STEAM project-based learning can increase students' creativity to think creatively, which is the implementation of 21st-century learning.

Table 2 shows the normality test results as a correlation prerequisite test. The data normality test is interpreted by comparing the significant values. The data is normally distributed if the Kolmogorov-Smirnov value and Asymp Sign value > significance value (0.05). Based on the table above

results, the project-based learning variable is 0.482, and the creative thinking variable has a value of Sig. 0.344, then the data is said to be normally distributed.

Correlation analysis to determine the level of relationship between project-based learning and creative thinking skills, a correlation test is carried out, as shown in Table 3.

Table 2 Normality Test

	Tests of Normality					
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Project	.288	3	.	.928	3	.482
Creative	.318	3	.	.887	3	.344

a. Lilliefors Significance Correction

Table 3 Correlation Test

Correlations			
		Project	Creative
Project	Pearson Correlation	1	.997*
	Sig. (2-tailed)		.046
	N	3	3
Creative	Pearson Correlation	.997*	1
	Sig. (2-tailed)	.046	
	N	3	3

*. Correlation is significant at the 0.05 level (2-tailed).

Table 3 shows the results of the project-based learning correlation test with students' thinking skills. Based on the SPSS calculation results, the Significance value is <0.05, so there is a relationship or correlation between project-based learning and students' creative thinking skills. The degree of the Pearson Correlation is 0.997, in the range of 0.80 – 1.000, so it can be categorized as a "Very Strong" correlation. At the same time, the direction of the relationship between project-based learning and creative thinking skills is included in the positive category with a Pearson Correlation value of 0.997.

The relationship between project-based learning and creative thinking skills is also supported by previous research by Sulistyowati & Roshayanti (2022); it was concluded that class XII MIPA SMA Sedes Sapientiae Semarang had an independent and creative attitude in carrying out biotechnology projects. This aligns with research by Saprahayungsih et al. (2022), which revealed significant differences in creative thinking skills and learning outcomes after students received classroom action treatment with a project-based learning model. After being given action with a project-based learning model, there was an average increase in creative thinking skills and student learning outcomes.

Research result by Ningrum et al. (2021) also shows that applying STEM from home with the PjBL model obtained an N-gain score of students

with a high category of 43% on concept mastery. Meanwhile, the student's N-gain in the medium category was 63% for creative thinking skills. Thus, applying STEM from home with the PjBL model can improve students' mastery of concepts and creative thinking abilities. This is reinforced by research by Nita & Irwandi (2021), that the project-based learning model can improve students creative thinking skills by giving systematic projects through making bioplastic preserves so that it can make it easier for students to understand Animal-Arthropods material. According to Gomez-del Rio & Rodriguez (2022), the benefit of creativity in science learning is that students are expected to have the courage to solve science problems in the surrounding environment. In this way, students can create several alternative answers and ideas so that students can solve these problems with appropriate and creative solutions.

With the application of a project-based learning model, it is hoped that the success of the learning process in science material will be more interesting and also make students familiar with outdoor learning so that they can present problems that exist in the real world, be responsible for students, and can improve students' thinking skills Nury et al. (2019) revealed that project-based learning was adapted as an early learning model that can direct students to increase persistence, creativity, and interest in learning science. In line with this, in research by Trimawati et al. (2020),

Project-based learning (PjBL) can motivate students to respond to good learning and improve students' critical and creative thinking so that it can be used as an alternative application of integrative learning to train students' activities in collaborating, communicating, and creating work or products and innovations to face the challenges of the century 21.

D. Conclusion

Based on the research that has been done, it can be concluded that there is a relationship or correlation between project-based learning and students' creative thinking skills on the theme of biotechnology. The degree of the Pearson Correlation is 0.997, in the range of 0.80 – 1.000, so it can be categorized as a "Very Strong" correlation. The direction of the relationship between project-based learning and creative thinking skills is included in the positive category, with a Pearson Correlation value of 0.997. The results show that the project-based learning model can influence relationships or correlations to train creative thinking skills in science learning. The learning process will not be monotonous and boring; students will find it easier to understand the material to be studied with various activities implemented by the project-based learning model.

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