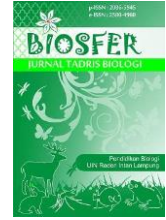




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How Are Students' Creative Thinking Skills Through Microbial Growth Rate Worksheet on Nata De Whey Kefir?

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ABSTRACT

Worksheets can be used as a solution to the success of the practicum process. This study aimed to analyze students' creative thinking skills through worksheets of microbial growth rates on nata de whey kefir. The method used in this research was a Pre-Experimental Design with a one-group pretest-posttest design. The population of this research was the sixth-semester Biology Education Study Program students. The research sample consisted of a class of 21 students selected using a purposive sampling technique. The research instrument consisted of description questions containing indicators of creative thinking. The results of the research data analysis obtained an average N-gain for each indicator of creative thinking skills of 0.461, which was included in the "medium" criteria. Test the data hypothesis using the T-paired test obtained a significance value of $0.000 < 0.05$. Therefore, H_0 was rejected, and H_1 was accepted. Based on the research results obtained, data showed that there was an increase in students' creative thinking skills through worksheets on the rate of microbial growth in nata de whey kefir.

Bagaimana Kemampuan Berpikir Kreatif Mahasiswa melalui Lembar Kerja Laju Pertumbuhan Mikroba pada Nata De Whey Kefir?

ABSTRAK: Lembar kerja dapat digunakan sebagai solusi dalam keberhasilan proses praktikum. Penelitian ini bertujuan untuk menganalisis keterampilan berpikir kreatif mahasiswa melalui lembar laju pertumbuhan mikroba pada nata de whey kefir. Metode yang digunakan dalam penelitian ini adalah Pre-Experimental Design dengan desain penelitian one-group pretest-posttest design. Populasi penelitian ini adalah mahasiswa semester VI Program Studi Pendidikan Biologi. Sampel penelitian menggunakan satu kelas yang berjumlah 21 mahasiswa dengan menggunakan teknik purposive sampling. Instrumen penelitian terdiri dari soal uraian yang memuat indikator berpikir kreatif. Hasil analisis data penelitian diperoleh rata-rata N-gain dari setiap indikator keterampilan berpikir kreatif sebesar 0,461 termasuk pada kriteria "sedang". Data uji hipotesis dengan menggunakan Uji T-paired diperoleh nilai signifikansi $0,000 < 0,05$ maka H_0 ditolak dan H_1 diterima. Berdasarkan hasil penelitian diperoleh data bahwa terdapat peningkatan keterampilan berpikir kreatif mahasiswa melalui lembar kerja laju pertumbuhan mikroba pada nata de whey kefir.

INTRODUCTION

The development of education is related to the times, especially in this era of

globalization in the 21st century, where high-level thinking skills are needed to overcome various problems (Ghafar,

2020);(Natsir et al., 2023). The educational paradigm states that today's human resources are required to think at a higher level, one of which is creative thinking (Puspita et al., 2024);(Haka et al., 2022).

Creative thinking skills create new ideas in producing a way to find new things to solve a problem (Imtihana & Utami, 2024);(Handoko et al., 2024). Creative thinking skills can be seen from expertise in analyzing data and providing responses to solving various problems (Hidayah et al., 2024). A high level of creativity is a sign that someone can think creatively (Achmad et al., 2024). Creative thinking indicators consist of four aspects. The first is thinking fluency, which is demonstrated by students' ability to generate ideas for solving problems. The second is flexible thinking (flexibility), which is shown by students' capacity to provide varied solutions from different perspectives. The third is original thinking (originality), reflected in students' ability to produce unique ideas that are either novel or uncommon compared to the thoughts of others. Finally, the ability to elaborate (elaboration) is indicated by students' skill in breaking down a main idea into smaller, more detailed ideas (Afifa et al., 2021);(Handayani et al., 2022).

Biology learning is very closely related to everyday life; in the learning process, students are required to be able to connect the theories studied with life events (Maryanti et al., 2021). Biology material has an important role in the process of teaching students about natural phenomena as a whole and meaningfully, or it can be said as a process of discovery, so it's not just a collection of objects, theories, and understanding of objects (Kadarisman et al., 2023). Learning biology can build creative thinking skills through direct activities, namely by doing a practicum (Yani et al., 2021). Therefore, teachers need to be able to optimize students' creative thinking competencies in learning biology through practicum activities, one of which is on

biotechnology material (Achmad et al., 2024).

Biotechnology is classified into two: modern biotechnology and conventional biotechnology (Azizah et al., 2023). Biotechnology practicum, especially conventional biotechnology, is carried out by the sixth-semester students of the biology education study program. Conventional biotechnology plays an important role in product processing by utilizing microbes to increase nutritional value, shelf life, and selling price and affects increasing food productivity (Kordi et al., 2022). In food biotechnology, microorganisms can change the substrate of a material into a different product through a fermentation process (Iram et al., 2021). The fermentation process produces a wide variety of food and beverage products (Rodríguez et al., 2020). Examples of the use of food and beverages, which include food biotechnology, include bread, tape, tempeh, soy sauce, yogurt, tauco, kefir, and nata.

Based on a preliminary study conducted on the eight-semester students who had previously used our biotechnology labs for making nata, the problem was that the students experienced difficulties in designing the practicum implementation and did not know the characteristics of microbes and the growth rate of microbes in making nata. In addition, students did not know about nata products whose substrates came from the utilization of kefir whey, which still contains good nutrition for the body. Whey kefir is produced from the process of making kefir, where milk is separated into curd and whey due to microbial activity. Whey kefir is considered a by-product (Levkov et al., 2021) because most people who consume kefir tend to prefer whey, which resembles milk, compared to whey kefir (Arona et al., 2021). However, whey kefir actually contains nutrients, namely carbohydrates, protein, and fiber (Arona et al., 2021). Therefore, it is necessary to have a worksheet that supports the success of the practical process of

making nata de whey kefir. This idea is in line with Rini & Aldila (2023), who, through practicum, students will develop their creative skills through activities to analyze the results.

Worksheets are teaching materials that can be used as support in the learning process and a solution to the success of the learning process, especially in practicum (Endrawati et al., 2023). The worksheets used are adapted to the learning material to be delivered. They are expected to improve the quality of student learning practicums and to determine the effectiveness of using worksheets on students' creative thinking skills (Santoso et al., 2023);(Fenanda et al., 2024). Through the worksheet used in the nata de whey kefir practicum, it is hoped that it can improve the quality of student practicum learning and find out the effectiveness of using the microbial growth rate worksheet on nata de whey kefir on students' creative thinking skills. This research is expected to contribute to the development of innovative learning approaches, increase students' understanding of the concept of biotechnology, and increase students' awareness of the importance of utilizing living things in scientific and engineering principles.

METHOD

This research employed the pre-experimental method due to the absence of a control class, and the samples were not randomly selected. The design used in this study was a one-group pretest-posttest. The population in this study were all sixth-semester students of the Biology Education Study Program at Sunan Gunung Djati State Islamic University of Bandung, which consisted of five classes with a total of 118 people. The sample of this research was 21 students from class VI E. The research sample was not determined randomly. Therefore, the sampling technique used was purposive sampling. The instrument used in this study was a test in the form of a

description of questions that included indicators of creative thinking. The aspects and indicators of creative thinking can be seen in Table 1.

Table 1. Aspects and Indicators of Creative Thinking

No.	Aspects of Creative Thinking	Indicators of Creative Thinking
1.	Fluency	Formulating ideas, answers, and conflict resolution Providing ways or suggestions for conflict Think of other answers to existing conflicts.
2.	Flexibility	Forming varied ideas, answers, or questions Looking at conflict from a different perspective Looking for many different solutions Have a different way of approaching.
3.	Originality	Creating new and unique expressions Thinking about ways that aren't the norm Have the ability to combine.
4.	Elaboration	Enriching the development of ideas Detailing an object more clearly in detail

Sumber: (Cahyani et al., 2022)

The analysis techniques performed were normality tests, paired sample t-tests, and n-gain tests. The normality test was done using the Shapiro-Wilk formula because the data tested was less than 50 samples. The paired sample t-test was one of the tests used to examine the effectiveness of the treatment, characterized by the difference in the average before and after treatment. Test n-gain was used to see whether there was an increase in students' creative thinking skills when students used the microbial growth rate worksheet on Nata de whey kefir.

RESULTS AND DISCUSSION

Based on the research carried out from March to May 2023, Table 2 shows the results of the data analysis.

Table 2. Data Normality Analysis Prerequisite Test Results

No.	Test of Normality			
	Test	Shapiro-Wilk		
1	Pretest 6E	0.938	21	0.201
2	Posttest 6E	0.929	21	0.129

Based on Table 2, it was obtained that the pretest significance value was 0.201, higher than 0.05. The obtained posttest result was 0.129, more than 0.05. Therefore, the two data were normally distributed. If the data obtained is normally distributed,

the hypothesis test that is applied is the paired sample t-test presented in Table 3.

Table 3. Hypothesis test results

Information	Mean	N	Df	Sig.	Conclusion
Pretest	75,43	21	20	0,000	Significant
Posttest	86,38				

Based on Table 3, the creative thinking skills of students who were given treatment showed a value of Sig. (2 tailed) or a significance value of 0.000, less than 0.05. The result indicated that H_0 was rejected or H_1 was accepted.

Furthermore, Table 4 presents students' creative thinking skills, as measured through the pretest and posttest.

Table 4. Descriptive Statistical Test Result

Test	Category	Statistic	
Pretest 6E	Mean	75.43	
	95% Confidence Interval for Mean	Lower Bound	70.53
		Upper Bound	80.33
	5% Trimmed Mean	76.16	
	Median	77.00	
	Variance	115.857	
	Std. Deviation	10.764	
	Minimum	45	
	Maximum	92	
	Range	47	
	Interquartile Range	13	
	Skewness	-.985	
	Kurtosis	1.910	
	Posttest 6E	Mean	86.38
95% Confidence Interval for Mean		Lower Bound	82.84
		Upper Bound	89.92
5% Trimmed Mean		86.95	
Median		87.00	
Variance		60.448	
Std. Deviation		7.775	
Minimum		65	
Maximum		97	
Range		32	
Interquartile Range		11	

The student's creative thinking skills, as measured through the initial test before the practicum, were excellent. Of the questions given to 21 students, an average score of 75.43 was obtained, which could be categorized as moderately good. The average value of student pretest results is caused by several factors that influence it,

namely internal and external factors (Safitri et al., 2023);(Resdasari et al., 2021) so that each student has different abilities in answering the pretest questions given.

Internal factors consist of individual physiological or physical factors, both innate. Among these factors are students not studying or reading before the practicum

learning activities take place. External factors that influence it include the environment and the student's own experience (Usher et al., 2024).

The result of pretest can make students motivated to better understand the material that will be practiced and make initial capital that cannot be ignored in achieving practicum success and an increased level of understanding in the form of increasing students' creative thinking skills (Rini & Aldila, 2023);(Simanjuntak et al., 2021).

The student's creative thinking skills after applying the microbial growth rate worksheet on nata de whey kefir obtained an average value of 86.38 in the excellent category. The highest acquired score was 97. Students' ability to work on posttests is influenced by the habit of students doing practicum and paying attention to and collecting data from a case that is available in the worksheet. This result relates to the worksheet used, where the microbial growth rate worksheet on nata de whey kefir directed students to find solutions to problems presented on worksheets. Through these solutions, they become independent in connecting problem solutions to the concepts they learn. Direct student involvement in solving the given problems causes students to easily remember the material (Sudirtha et al., 2022).

The data from the N-gain analysis results for each indicator of creative thinking skills are presented in Table 5.

Table 5. N-Gain Analysis Result for Each Indicator of Creative Thinking Skills

Indicator KBK	VI E Biologic			Criteria
	Pretest	Posttest	N-Gain	
Fluency	76,68	91,85	0,650	Medium criteria
Flexibility	78,96	88,09	0,405	Medium criteria
Originality	76,18	81,74	0,269	Low criteria
Elaboration	69,04	84,91	0,519	Medium criteria

Based on Table 4, the average N-gain results for each indicator of creative thinking skills showed a significant increase from before the treatment to after the treatment in each indicator: fluency, flexibility, originality, and elaboration. The average N-gain value for students' creative thinking skills was 0.461, which falls into the medium category. The improvement in thinking skills across each indicator ranged from 0.26 to 0.65, falling within the low and medium categories. The highest achievement was observed in the fluency indicator, which involves generating many ideas and answers, solving problems or questions, suggesting multiple ways to solve problems, and consistently thinking of more than one answer (Agusta, 2021). The achievement of fluency indicators falls into the medium category with an N-gain value of 0.650. This indicates that students are now able to offer numerous solutions and questions. This improvement is attributed to the practicum, where students work through worksheets on the rate of microbial growth in nata de whey kefir. The worksheets allow students the opportunity to share ideas or opinions on the discourse provided by the researchers. The findings are in line with the opinion of Handayani et al. (2021) that students who have fluent thinking skills (fluency) are students who can convey ideas.

The second indicator of creative thinking skills is flexibility. The achievement of flexible thinking indicators is included in the medium category with an N-gain value of 0.405. The achievement of this indicator is marked by students' ability to answer various kinds of questions that direct them to formulate problems and make hypotheses based on the discourse given during practicum. Through learning that presents student activities, the students can answer questions with indicators of flexible thinking so that there is an increase in these indicators. This finding is in line with Franco-mariscal et al. (2024) and Smith et al. (2022) that the ability to think flexibly can change approaches or thoughts, provide

interpretations of stories or problems, apply concepts or principles in various ways, and solve problems in various ways.

The third indicator of creative thinking skills is originality. The achievement of original thinking indicators is included in the low category with a score of 0.269. The achievement of this indicator is supported by asking students to provide ideas in the form of designing a packaging idea for making products by utilizing nata de whey kefir. This activity stimulated students to respond with answers that come from their ideas and can find ideas that are unique and different from other students. Learning activities that involve students in active exploration can improve creative thinking skills, one of which in this study is marked by an increase in indicators of original thinking (Mariyam et al., 2020);(Sukri et al., 2022).

The fourth indicator of creative thinking is elaboration. Achievement of the ability to detail indicators is in the medium category with an N-gain value of 0.519. Student activities support the achievement of this indicator. They pay attention to details during the practicum activities by describing the manufacturing steps, starting from the preparation to manufacturing. Students were also asked to criticize the advantages and disadvantages of the nata de whey kefir. Student activities during this practicum have supported an increase in detailing indicators (elaboration) so that they can answer posttest questions with these indicators (Sajidan et al., 2022);(Anwar et al., 2024). This finding is in line with Yildirim et al. (2023) that detailed thinking is the ability to enrich, develop, add, describe, or detail the details of objects, ideas, ideas, products, or situations so that it is more interesting.

CONCLUSIONS AND SUGGESTIONS

Based on the discussion, creative thinking using the microbial growth rate worksheet on nata de whey kefir was effectively practiced. It was evidenced by the

significance value of the pretest of $0.021 > 0.05$ and the results of the posttest with a significance value of $0.129 > 0.05$. The results indicated that the two data were normally distributed. Furthermore, there was an increase in creative thinking skills of 0.461 in the medium category. N-gain analysis was also carried out for each indicator of creative thinking skills, namely fluency, flexibility, and elaboration in the medium category and originality in the low category.

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