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The Effect of Blended Learning Model on Creative Thinking Ability in High School Students

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Abstract

Background: This study aims to determine the influence of blended learning models on the creative thinking ability of high school students on biotechnology materials at SMA N 1 Sukaraja, Sukabumi Regency. **Method:** The method used in this study is the research design experiment used, namely the Non-equivalent Control Group Design. The sampling technique uses purposive sampling. The research instrument used is a description question test of 8 integrated with five indicators of creative thinking ability (Fluency, Flexibility, problem sensitivity, Originality, and Elaboration). **Result:** Based on the study's results, the experiment class's average N-gain of creative thinking ability is 0.72 with high criteria, while the control class is 0.46 with medium criteria. In the hypothesis test using the independent sig (2-tailed) test, which is 0.00<0.05, Ho was rejected. The influence of blended learning models on creative thinking ability helps the learning process between the experiment and control classes. **Conclusion:** It is concluded that there is an influence on the use of blended learning models on the creative thinking ability of class XII students on biotechnology materials at SMA Negeri 1 Sukaraja.

Keywords: Blended learning; Biotechnology; Creative thinking.

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Introduction

21st-century learning prepares the 21st century generation to face various global demands and challenges; where in this century, advances in technology and information are developing very rapidly and affecting all areas of human life, one of which is in the field of education. In the future, learning challenges in the 21st century, students must have several skills, which consist of 4C, namely creative thinking skills, critical thinking and problem solving, communication, and collaboration (Hudayati et al., 2021). Creative thinking skills are one of the 21st-century skills that must be developed in the learning process. Creative thinking is an exciting idea related to cognitive skills and the ability to come up with solutions in solving problems in learning. The ability to think creatively is vital for all individuals, especially in the era of the world economy, which relies on science and technology (Haka et al., 2020).

Creative thinking is one of the peak developments in a person's growth stages. There are five indicators of creative thinking according to Guilford (1968), namely (1) sensitivity (problem sensitivity), the ability to detect (recognize and understand) and respond to a statement, situation, and problem; (2) fluency, namely the ability to make as many innovations as possible; (3) flexibility, namely the ability to overcome mental obstacles when issuing innovations. To show in the absence of the same innovation when a person is asked to express an innovation or opinion; (4) originality, namely the uniqueness of the

idea or innovation expressed; (5) elaboration, namely the ability to detail each idea so that a simple stimulus becomes more complex (Ruzniar et al., 2018).

To optimize creative thinking skills, students must learn independently to hone creative thinking skills in students (Haka et al., 2020). The low ability to think creatively in Indonesia is shown from the TIMSS source (Trends in International Mathematics And Sciences Study) in 2015, showing that Indonesia is ranked 44th out of 49 countries with a score of 397; low creative thinking ability will have an impact on the low ability of students in solving science problems (Mukti & Soedjoko, 2021). One of the science lessons that can foster creative thinking is biotechnology materials. The selection of Biotechnology material because it is part of science that can display students' creative abilities, for example, in making fermented products and food conservation (Agustina et al., 2015). When taking place in school, biotechnology material can foster logical, critical, and creative attitudes toward the symptoms of nature that exist around it, such as the manipulation of organisms to produce products so that students can reason the relationship between a symptom or natural event to one another so that students can create a scientific mindset (Septari, 2020). To overcome this, a learning model is needed that can train students' creative thinking skills. Based on these problems, the learning process can be carried out optimally; it is necessary to develop a learning model and method that is by the current situation that can be applied to the learning process. Learning models that are interesting to learners can stimulate learners in the learning process. A teacher must be able to choose learning media that are suitable and suitable for use so that the teaching goals that the school has set are achieved (Nurrita, 2018). One of the meaningful learning methods in the 21st century can be applied together with e-learning programs, showing that e-learning effectively eliminates distance and change, one of which is by applying blended learning methods (Agustino et al., 2020).

Blended learning combines classroom learning (face-to-face) and online learning. Blended learning provides clear benefits for creating learning experiences by presenting the proper learning to each individual (Husamah, 2014). There are five keys to implementing learning using blended learning. The first is that in-person or face-to-face learning (instructor-led instruction) occurs at the same time and in the same place (class) or at the same time but in a different location (virtual class). This pattern can also combine theories of behaviorism, cognitivism, and constructivism to achieve meaningful learning; the second is self-paced learning which combines independent learning with various content (learning materials) specifically designed for independent learning, both text-based and multimedia-based, allowing participants to learn anytime, anywhere. The third is that collaboration is aimed at constructing knowledge and skills through social processes or interactions with others, as well as material deepening, problem-solving, and project-based learning. Fourth is the assessment design, and blended learning must be a mixture of test and non-test assessment types. Learners can follow the learning comfortably and flexibly. The fifth is the learning medium. If we want to combine face-to-face learning in the classroom with virtual face-to-face learning, researchers must consider the resources available to support it, whether it is ready or not. Learning materials are made in digital format, both those that can be accessed by learning participants offline (in the form of CDs, MP3s, and DVDs) and online (on the internet) (Sumandiyar et al., 2021).

From the overall strategy integrated with blended learning, it is hoped that students can improve their creative thinking skills. This kind of learning model places students as student-centered, which provides opportunities for students to learn actively in exploring their creativity so that they can grow and develop the power of creation, innovation, reason, and experimentation to find new possibilities in the future.

Method

Quantitative research is a research design that uses data from scores or numbers and statistics for its analysis (Rukminingsih et al., 2020). The Quasi-experimental method

has a control class but cannot function entirely because there are external variables that cannot be controlled by the researcher (Sugiono, 2018). The quasi-experiment method is used to determine the creative thinking ability of students using a blended learning model. This study aims to determine the creative thinking ability of high school students by using a blended learning model on biotechnology materials.

Samples and population

This research was carried out at SMA Negeri 1 Sukaraja for the 2021/2022 school year. The study population was class XII IPA 1 as an experimental class with a total of 33 people and XII 6 as a control class totaling 31 people.

Instruments

The instrument used in this study is a test to measure creative thinking in the form of a description question test for pretest and post-test as many as eight questions from creative thinking indicators, namely fluency, flexibility, problem sensitivity, originality, and elaboration. In the experimental class, observation sheets and questionnaires of students' responses to learning activities using a blended learning model are used to determine students' creative thinking levels after learning.

Data Analysis

The data were analyzed using SPSS 25. After calculations on the pretest and post-test values in the experiment class and control class by calculating N-gain, statistical tests were then carried out, namely normality tests, homogeneity tests, and hypothesis tests.

Result

Based on the results of research conducted at SMAN 1 Sukaraja, data was obtained from students who use the blended learning method (experimental class) and groups of students who carry out learning with discovery learning (control class). The following presents a recapitulation of pretest and post-test values in N-gain in the experimental and control classes.

Table 1. Learners' creative thinking ability test scores

Class	Average of Values			Description
	Pretest	***Posttest***	***N-Gain***	
Experiment	45	84	0.72	Tall
Control	49	73	0.46	Keep

Table 1 shows the results of the recapitulation of the value of the student's creative thinking ability test with an increase in creative thinking ability. It can be seen that the experimental and control classes showed differences in the time before learning with the pretest and after learning with the post-test in the experimental and control classes. The average pretest score of the control class is 49, while the average value in the experimental class is 45. After the learning process was carried out in each class, it improved the creative thinking ability test. Can be shown in table 1. Obtained indigo post-test control class with an average score of 73; in the experiment class, a score of 84 was obtained. The average gain of pretest scores and post-test values in each class can be seen in the graph below.

Statistical tests are carried out in the experiment and control classes using SPSS 25 for normality, homogeneity, and hypothesis tests. Based on the results of the analysis of statistical calculations as follows:

Table 2. Normality test with Shapiro-Wilk

Class	Statistic	df	Sig.	Criteria
Pretest experiment	0.946	32	0.172	Normally distributed

Class	Statistic	df	Sig.	Criteria
Posttest experiment	0.939	32	0.72	Normally distributed
Pretest control	0.957	33	0.212	Normally distributed
Post-test control	0.948	33	0.117	Normally distributed

Table 2 shows the calculation results on the normality test using SPSS 25 in the control and experiment classes, which is normally distributed because it is said that in the Sig. Value or signification <0.05, then the distribution is abnormal. The distribution is normal if the Sig Value or signification >0.05. In the test results with Shapiro-Wilk, it is shown that the value of each post-test and pretest in the control class and the experiment class showed a signification value of >0.05, which can be said that in the normality test in table 2 for creative thinking ability tests the experiment class and the control class is normally distributed.

In the homogeneity test using the Levene test in the SPSS 25 application, this homogeneity test aims to determine the level of diversity of the two groups, homogeneous or heterogeneous, in the experiment class and control class. In this homogeneity test, using creative thinking ability test data can be seen in table 3.

Table 3. Homogeneity test result

Class	*Levene statistic*	Df1	Df2	sig
Based on mean	0.946	32	0.172	0.51
Based on median	0.939	32	0.72	0.57
Based on median and with adjusted df	0.957	33	0.212	0.59
Based on trimmed mean	0.948	33	0.117	0.50

Table 3 shows the results of the homogeneity test calculation using SPSS 25 on the creative thinking ability test of the experimental and control classes. In using the Levene test, it is said that if the value of the Levene statistic >0.05, then it can be said that the variation of the data is homogeneous. Based on the output results, the value of the signification based on the mean is 0.051, which can be concluded to mean that the two classes are not significantly different; it means that the variance of the two classes compared is homogeneous.

Based on the results of the analysis of creative thinking ability to be normally distributed and has a homogeneous variance, then an independent test was carried out; the number of members in the experiment class was 32 students in the control class of 33 students, then a z test was carried out, along with the results of the hypothesis test on the creative thinking ability test in table 4.

Table 4. Hypothesis test results on creative thinking ability

Class	Levene's Test for Equality of Variances		Best For Equality of Means					95% Confidence Interval of The Difference	
	f	Sig.	t	Df	Sig (2-Tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variance assumed	3.970	0.51	7.876	63	0.00	9.603	1.216	7.876	12.040
Equal variance not			7.933	53.057	0.00	9.603	1.216	7.175	12.031

Table 4 shows the results of hypothesis testing in the study using SPSS 25 from the results of the output above, showing in the output results obtained that a sig (2-tailed) value of 0.000 < 0.05 can be concluded that learning using blended learning affects the ability of creative thinking there is a difference in the average learning outcomes of participants between learning in the experimental class and the control class. So H_0 is rejected, and H_1 is accepted, meaning that there is a significant difference in the use of

blended learning methods with conventional learning, namely discovery learning, in improving students' creative thinking skills.

The creative thinking ability used in this study is by using five indicators of creative thinking, which include (1) Sensitivity (problem sensitivity), (2) Fluency (fluency), (3) Flexibility (flexibility), (4) Authenticity (originality), and (5) Elaboration (elaboration). The results of the calculation of the comparison of each indicator can be seen in the differences and improvements presented in table 5.

Table 5. The result of each indicator of the creative thinking ability

Indicators	Experiment Class	Information	Control Class	Description
Fluency	89	Excellent	77	Good
Problem Sensitivity	77	Good	73	Good
Originality	78	Good	63	Good
Elaboration	83	Excellent	65	Good
Flexibility	79	Good	68	Good

Based on table 5, comparing each indicator in the experimental and control class, the fluency indicator (fluent thinking) with the percentage of the average score in the experiment class is 89%. In the control class, with an average score of 67.36%, the experiment class obtained a superior score compared to the control class. The difference in average scores can be caused because, in the control class, students have not been honed well in their ability to fluency (thinking fluently) because in learning using the discovery learning model, many teachers dominate the learning process compared to experiment classes, there are many discussions with students by applying student-centered learning in learning. This indicator is included in the indicators that have a higher value than others where students are required to express and produce many ideas in situations; this fluency indicator is trained using student worksheets in the experiment class presented problems from the differences between conventional biotechnology and modern biotechnology where students are required to produce many ideas from observation results (Serevina & Meyputri, 2021).

This student response questionnaire is carried out after the learning process, aiming to find out the response of students in the experiment class after learning using the blended learning method. This interview consists of 3 aspects in which ten questions are given to each student. Here's table 6 on learners' responses.

Table 6. The results of the response of students in the experiment class

Aspects Revealed	Average	Description
Student response to the use of Blended learning models in biotechnology subjects	82%	Excellent
Students' interest in the Blended learning model in learning Biotechnology material	80%	Excellent
Clarity and ease of learning using blended learning models in biotechnology material learners	72%	Good
Average	**78%**	**Good**

Based on the results of table 6. That is the questionnaire of student responses that aspects (1) regarding the tagging of students towards the use of blended learning models in biotechnology subjects were obtaining a score of 82% with excellent criteria, on aspects, (2) students' interest in blended learning models in learning Biotechnology materials has an average value of 80% with excellent criteria, and (3) ease of learning using blended learning models in learning Biotechnology materials obtained a value of 72% with good criteria. The average of all aspects is 78%, so it can be said to be included in the good criteria.

Discussion

Based on research that has been carried out on the experiment class and control class used in the research sample. The experimental class was given treatment using the blended learning method, while the control class was given treatment with the discovery learning method. The study's results in table 1 show that the average value in the N-gain of the experiment class is 0.72 with high criteria, while in the control class, the value of N-gain is 0.46 with medium criteria. The N-Gain in the experimental class is higher than in the control class because the mastery of concepts in the experimental class is also more improved compared to the control class. Learning using a blended learning model has facilitated experimental class students in learning so that students are motivated to master learning concepts so that in experiment classes experience an increase in science process skills and cognitive learning outcomes before and after the implementation of learning.

Results obtained from N-Gain after hypothesis testing based on table 4. show a significant difference, namely, the significance value (Sig.2-tailed) is 0.00 < 0.05, meaning that H_0 is rejected and H_1 is accepted, then using a blended learning model applied in the experiment class affects the creative thinking ability of students (Nuryadi et al., 2017).

In learning in the classroom, experiments using a blended learning model are carried out with two meetings with stages of learning activities with three stages. (1) at the planning stage of learning activities, students are given pretest questions that aim to determine the level of creative thinking ability of students before the implementation of learning. Furthermore, an overview of the activities to be carried out using the blended learning method is given, after which students are grouped into three groups. (2) at the implementation stage, two learning activities are carried out, namely online and offline. In online activities, students are given student worksheets for online learning to understand better what they should discuss in the student worksheets. Furthermore, in offline activities, student worksheets are given for offline learning, a continuation of student worksheets for online learning, where students must train creative thinking in making innovations by the orders in the student worksheets. (3) in the follow-up stage, students discussed with the group, which aims to exchange information and exchange ideas in problem-solving after the learning activity, then made a percentage of the discussion results (Husamah, 2014). After the learning, a post-test is carried out to show an increase in the creative thinking of students, and a questionnaire sheet for student responses to find out the response to the learning model that has been carried out. In the control class, it is carried out using a discovery learning model as in the experiment class, and the teacher gives a pretest of the creative thinking ability of students first before learning. The teacher conveys the learning objectives and discussions and continues with material provision. After that, followed by the division into four discussion groups to work on the student worksheets provided, this discussion aims to improve the improvement in the mindset of students after learning. When doing the learning, it is treated the same, but in the classroom, the experiment uses a blended learning model. The results of the study using a test about the creative thinking ability of students showed an increase, but in the experimental class, it was higher than in the control class.

The influence of blended learning models on students' creative thinking abilities

The results of the processing research source (Table 1) show that the blended learning model in the experiment class significantly affects students' creative thinking ability. In the experiment class using the blended learning model, they get an online and offline learning experience compared to the discovery learning model. In the experiment class, students can experience learning online learning activities by using video conference or zoom applications in learning and offline activities with face-to-face meetings by discussing directly between friends. This shows the role of students in learning more actively and enjoyably when learning is carried out offline and online. Students who experience new experiences with activities carried out using a blended

learning model by making innovations from yogurt in learning add creative thinking ability to create things. Implementing this blended learning model is beneficial in learning during a pandemic and getting a learning experience outside the classroom. The understanding of blended learning is that this learning is a combination of conventional learning with e-learning. There are four components in blended learning, including face-to-face learning, offline e-learning, online e-learning, mobile learning, and taking into account the needs in learning (Husamah, 2014). Efforts towards learning only in the classroom with information are more efficient so that students can improve creative thinking skills in learning. With this statement, it is proven that a blended learning model can increase students' creative thinking ability during learning to observe videos and conduct investigations into problems given in biotechnology materials for making yogurt.

Comparison of creative thinking abilities of each indicator

The problem sensitivity indicator in the experiment class scored an average score of 77%, and the control class got an average score of 73%, in both classes had almost the same percentage of average scores. This indicator of problem sensitivity is the ability to detect (recognize and understand) and respond to a statement, situation, and problem by being given student worksheets to identify a problem (Yunianta, 2009). In the experiment class, problems were given by observing both types of biotechnology and identifying other statements, while the control class made observations with differences in the research results.

The originality indicator in the experiment class got an average score of 78%, and in the control class, with an average score of 63%, both classes got moderate criteria. The two classes received moderate criteria because the experiment class in the learning process of students did not hone their originality thinking skills in learning more referring to the questions in the student worksheets given to students. In contrast, in the learning control class, many were controlled by the teacher. On the indicator of originality, students are expected to be able to think of something problem or something that no one else has ever thought of (Serevina et al., 2021).

In the elaboration indicator (thinking in detail), the experiment class got an average score of 83%, while the control class got an average score of 65%. The reason is that there are many activities to hone elaboration in the experiment class, such as detailing innovative activities in making yogurt and re-explaining in detail with percentages in front of the class. While the control class only races on the existing student worksheets even though the percentage is carried out so that students cannot communicate in more detail, which causes lower elaboration indicators (Serevina et al., 2021).

The flexibility indicator in the experiment class got an average score of 79% higher than the control class's average score of 68%. The ability of flexibility indicators, namely to overcome mental obstacles when issuing ideas, must be shown by students. Still, the control class does not encourage enthusiasm because students only focus on learning in student worksheets, racing against the material. In this indicator, a person must have various interpretations of a story or problem; if a problem is explained, they usually think differently (Serevina et al., 2021).

Overall, the creative thinking indicators in the experiment class are better than those in the control class. The comparison of each indicator of creative thinking ability of experiment class students is proven in the use of blended learning models to bring students to experience new experiences that make students more able to observe/make observations freely, and students can also consider a report on the results of observations that they have done. In control classes that carry out learning using the discovery learning model, students are more passive in learning because students get learning experiences only based on the theory presented. The students cannot go too far to criticize a conflict.

Rhodes (1961) suggests that creativity is reality, where a person (person) communicates a new concept (product) that is obtained as what will happen comes from

a mental process (process) in forming inspiration, which means an effort to meet the needs (press) that are influenced by ecological pressures. The discussion of creativity contains four things: person, process, press, and product (Fatmawati, 2018). The creative mindset of participants in solving problems is determined by the three aspects of creative thinking ability, namely aspects of elaboration, problem sensitivity, fluency, flexibility, and aspects of originality; by fulfilling the five aspects of creative thinking ability, students will be able to resolve conflicts effectively (Mahmudi, 2010). Similar to what will happen in research by Hwang et al. (2007), aspects of the creative thinking ability possessed by a person will be a critical factor that stimulates him to create knowledge in problem-solving activities (Dirlanudin, 2018).

Based on the results that have been presented, the use of a blended learning model on the creative thinking ability of high school students in the learning process of students is active and enthusiastic learning because students get new experiences from learning using this blended learning model so that this model can increase students' interest in learning in biotechnology materials that have been implemented (Husamah, 2014).

Conclusions

The development of e-learning learning models as part of blended learning is developed into an effective model for developing students' abilities in creative thinking. Based on the results of the research that has been carried out, data from the results of hypothesis tests showed signification (2-tailed) which was obtained by 0.00 < 0.05, that there was an influence in learning using blended learning models on the creative thinking ability of high school students in class XII biotechnology material at SMAN 1Sukaraja. The test results showed that the indicator of creative thinking ability in the experiment class had a high score compared to the control class. The experiment class obtained the N-gain value was 0.72, while the control class was 0.46. The highest creative thinking ability indicator in the experiment and control classes is found in the fluency indicator (thinking smoothly), which is the ability to make as many innovations as possible. The results of students' responses from blended learning positively influence the results of 78% on applying the blended learning model.

Declaration statement

The authors reported no potential conflict of interest.

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