

The effect of problem-based learning using VARK approach on biology students' creative thinking skills

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Abstract

Learning that does not enable creative thinking skills does not facilitate student learning styles. This study aims to determine the effect of the PBL learning model with the VARK approach on the creative thinking skills of Biology students. This research uses quasi-experiment. The research subject was the 58 third-semester of Bachelor's Degree students in the Department of Biology who took the Plant Physiology course. Data analysis used a single ANCOVA. The results showed that the PBL models with the VARK approach to creative thinking skills were 0.000, which means less than 0.05. These results prove that the research hypothesis is accepted, which means that the application of the learning model has a significant effect on students' creative thinking skills. The results of the 5% on LSD further test for the difference in the results of the two classes were 86.551 for the experimental class using the PBL model with the VARK approach, and 77.828 for the control class using the PBL models without the VARK approach. These results indicate that creative thinking skills using the PBL with the VARK approach have a higher effect than the PBL model without the VARK approach. However, the PBL models with the VARK approach effect increasing the creative thinking skills.

Abstrak

Pembelajaran yang kurang memberdayakan keterampilan berpikir kreatif tidak memfasilitasi gaya belajar mahasiswa. Penelitian ini bertujuan untuk mengetahui pengaruh model pembelajaran Problem-based Learning (PBL) dengan pendekatan VARK terhadap keterampilan berpikir kreatif mahasiswa biologi. Metode penelitian ini kuasi eksperimen. Analisis data menggunakan anakova tunggal. Hasil penelitian menunjukkan model pembelajaran PBL dengan pendekatan VARK terhadap keterampilan berpikir kreatif sebesar 0,000 artinya lebih kecil dari 0,05. Ini membuktikan bahwa hipotesis penelitian diterima, artinya penerapan model pembelajaran berpengaruh signifikan terhadap keterampilan berpikir kreatif mahasiswa. Hasil uji lanjut BNT 5% terhadap perbedaan hasil kedua kelas yakni 86,551 untuk kelas eksperimen dengan penerapan model PBL dengan pendekatan VARK, sedangkan 77,828 untuk kelas kontrol dengan penerapan model PBL tanpa pendekatan VARK. Hasil tersebut menunjukkan bahwa keterampilan berpikir kreatif yang menggunakan PBL dengan pendekatan VARK memberikan pengaruh lebih tinggi dibandingkan dengan model PBL tanpa pendekatan VARK. Untuk itu model pembelajaran PBL dengan pendekatan VARK berpengaruh terhadap peningkatan keterampilan berpikir kreatif.

A. Introduction

21st century skills can be achieved through an educational process that provides facilities for students in developing their potential (Singh et al., 2020). Rotherham & Willingham, (2009) states that a student's learning success depends on their 21st century skills. Everyone needs applied and academic abilities to connect knowledge with skills, between creative and adaptive, and able to transform all these aspects into every problem solving (Zubaidah, 2016). Science development is designed to involve students in three aspects of activity, rationale, research, and relevance (Boholano, 2017). These three aspects lead to learning that develops 21st century life skills (Hariadi et al., 2018). Some of the competencies critical to master to meet the needs of 21st century life skills are 1) critical thinking & problem solving, 2) communication, 3) collaboration and 4) creativity & innovation (Partnership for 21st, 2012). These skills are necessary for the 21st century, one of which is creative and innovative in analyzing, developing, and compiling every information acquired (Wilcox et al., 2017).

Creativity is very important for students, making them continue to innovate in the learning process so that students are accustomed to solving problems in the future (Hilmi et al., 2020). Learning can be successful if the purpose of the learning objectives is met, and students are active in developing talents so that they can bring out their creativity and independence. Widiyansah et al. (2019) state that complex, divergent, and metaphorical thought can be expressed in a variety of ways, it is characteristic rather than creative thinking skills. According to (Kurniati et al., 2018) it is important to provide sufficient space for student creativity.

The results of the needs analysis are based on the initial ability of student thinking skills carried out by researchers on 04 November 2022 through an essay test to 30 students of S1 Biology Education, The State University of Malang who participated in the Plant Physiology course, it was proven that it was still relatively low. These results are shown from achievements below sixty percent, namely by 51% fluency, 55% originality, 49% flexibility, and 55% elaboration. This is because the learning used has not fully empowered creative thinking skills, so students are less able to make an assumption or creative idea. That it is proven that the learning used has not fully empowered the skills of creative thinking. These skills can be obtained by applying collaborative learning, PBL is one of the collaborative learning, collaborative learning students, can build knowledge easily (John & Sons, 2019), so the

chosen model is a problem-based and collaborative PBL model. The Problem-based Learning (PBL) model is one of the problem-based collaborative learning. PBL models start with complex real life (Ledesma, 2016) and engage in collaborative learning to manage an increasingly diverse student population (Guilherme et al., 2016; Kang et al., 2015).

PBL models are student-centered (John & Sons, 2019) so PBL provides a learning environment suitable for student learning styles (Caesar et al., 2016; Kong et al., 2014). The learning approach is something that needs attention so that the learning process can run smoothly. A learning approach that has a different learning style is the VARK approach. The VARK approach is an acronym for the four main learning styles visual, and auditory. reading-writing, dan kinestetik (Mayarnimar & Taufina, 2017). This can be beneficial for students who have more than one learning style because the student has an easier way of seeing and accepting their learning environment (Othman & Amiruddin, 2010). The VARK approach is used with the aim that there is a compatibility between the learning styles of multimodal students (visual, aural/audio, read/write, kinesthetic) with lecturer teaching strategies (Nengsih et al., 2021). Following the results of the study by Gilakjani, (2011) which states that the existence of compatibility between student learning styles and the way educators teach will help motivate the student's learning process.

Based on the explanation above, it is necessary to conduct a study to determine the influence of the PBL model with the VARK approach on students' creative thinking skills. The effectiveness of using the model is expected to contribute innovative ideas in improving the quality of learning.

B. Material and Method

This research is included in the type of quantitative research using quasi-experiments with the research design used, namely pretest-posttest nonequivalent control group design (Sugiyono, 2017). Pretests are given at the beginning of learning in experimental and positive control classes, while posttests are given at the end of learning. The learning used in the experimental class uses the Problem-based Learning learning model with the VARK Approach, while the positive control class uses the Problem-based Learning model without a VARK approach.

This research was carried out on students of the class of 2020/2021, Department of Biology, the State University of Malang who are taking the third semester (odd) and are programming the Plant Physiology course. This study used a population consisting of 6 classes, namely Offering A, B, C, G, H, and I. Sampling began with conducting an equality test based on the GPA score of each student of the class of 2020/2021, Department of Biology, State University of Malang. The results of the equality test showed that the six classes had been equal based on the results of significant values showing more than 0.05. Sample determination using a random sampling technique. 2 classes were selected, namely Offering H as the experimental class and Offering I as the positive control class.

Data collection using an essay test totaling 10 questions made based on indicators of creative thinking skills according to Treffinger (2002) which consists of indicators of fluency, flexibility, originality, and elaboration. The questions that will be used to take data must pass trials that aim to determine the validity and reliability of the questions. The data that has been obtained will be tested for prerequisites consisting of a normality test and a variance homogeneity test. The data normality test uses the Kolmogorov-Smirnov test using the help of SPSS 16.0 to determine whether the distribution data is normal or not normally. The variance homogeneity test uses Levene's Test of Equality of Error Variances using the help of SPSS 16.0 to determine the homogeneity of the variant. It was then tested using covariance analysis (ANCOVA) to determine the influence of the learning model used on creative thinking skills.

C. Results and Discussion

1. Test the prerequisites of bound variables results of creative thinking skills

The prerequisite test is carried out before the hypothesis test which aims to find out whether the data is normal using the Kolmogorov-Smirnov test and homogeneous or the same using the Levene's Test. The results in the normality test of the distribution of data on creative thinking skills can be seen in Table 1.

The results of the pretest and posttest normality tests of creative thinking skills show that it is known that the pretest results have Asymp. Sig./ (2-tailed) is 0.511, while the posttest has Asymp. Sig. (2-tailed) by 0.606. Based on the normality test criteria in the results above, it shows that $0.511 > 0.05$ and $0.606 > 0.05$ so, it can be concluded that the two data are normally distributed. Meanwhile, the results of the

homogeneity test of the test data variants can be seen in Table 2.

Table 1 Normality Test Results of Creative Thinking Data Distribution

		One-Sample Kolmogorov-Smirnov Test	
		Pretest	Posttest
N		58	58
Normal	Mean	44.00	82.19
Pawrameters ^a	Std. Deviation	10.26	6.997
		7	
Most Extreme	Absolute	.108	.100
Differences	Positive	.052	.092
	Negative	-.108	-.100
Kolmogorov-Smirnov Z		.821	.762
Asymp. Sig. (2-tailed)		.511	.606

a. Test distribution is Normal.

Table 2 Homogeneity Test Results of Data Variants of Creative Thinking Skills

Test of Homogeneity of Variances				
	Levene Statistic	df1	df2	Sig.
A	6.816	1	56	.053
B	.371	1	56	.545

Description:

A = Pretest Creative Thinking Skills

B = Posttest Creative Thinking Skills

Based on the results of Levene's test in Table 4.5 above, based on the signification value obtained, it is known that the pretest result has a signification value of 0.053 meaning Sig. 0.053 > 0.05 and the post-test result has a signification value of 0.545 meaning Sig. 0.545 > 0.05, then it can be concluded that the pretest and posttest results of both groups have the same or homogeneous variants.

2. Test the variable hypothesis of creative thinking skills

Research data from the test results of the analysis of learning models on creative thinking skills using a single ANCOVA test can be seen in Table 3. This shows that based on the results of testing data show a significant 0.000 less than α value of 0.05. The test results show that the research hypothesis is accepted, so it can be stated that the application of the learning model has a significant effect on students' creative thinking skills. Furthermore, a summary of the advanced test between the PBL learning model with the VARK and PBL approaches without the VARK

approach to creative thinking skills can be seen in Table 4.

Table 3 Hypothesis Test of Learning Models against Creative Thinking Skills

Tests of Between-Subjects Effects						
Dependent Variable: Posttest						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1123.674 ^a	2	561.837	18.534	.000	.403
Intercept	18945.984	1	18945.984	625.003	.000	.919
XCreative Model	2.553	1	2.553	.084	.773	.002
Error	1072.774	1	1072.774	35.389	.000	.392
Total	1667.240	55	30.313			
Corrected Total	394589.000	58				
	2790.914	57				

a. R Squared = .403 (Adjusted R Squared = .381)

Table 4 Advanced Test of PBL with VARK and PBL Approaches to Creative Thinking Skills

Estimates					
Dependent Variable: Posttest					
Learning model	Mean	Std. Error	95% Confidence Interval		Notation LSD
			Lower Bound	Upper Bound	
PBL-VARK	86.551 ^a	1.030	84.487	88.614	a
PBL	77.828 ^a	1.030	75.765	79.892	b

Table 4 shows that students' creative thinking skills in the PBL model combined with the VARK approach are higher than in the PBL model without being combined with the VARK approach. The difference is in the average creative thinking skills of the PBL learning model with the VARK approach was 86.551 while the PBL learning model was 77.828. So, from the average comparison, there are significant differences between each PBL learning model combined with the VARK approach with the PBL learning model without being combined with VARK.

Based on the analysis of the average difference between posttest and pretest in both classes, it showed a higher difference in values in the experimental class than in the control class. This is because the PBL model with a VARK approach is problem-based that requires students to present problems, ask questions, and facilitate investigations, and students use their learning style. Supported by the learning media used are

students' worksheets, which can help their learning style, so that students can more easily remember, process, and learn something. The VARK learning style owned by students is facilitated in each stage of the Problem-based Learning learning model. The use of learning materials can facilitate the learning style possessed by students, thereby training creative thinking skills, and students are easier to solve problems presented in learning. Based on their learning style, students can more easily learn something by remembering, and processing the things they get in learning. Based on these results, it is proven that the stages of the Problem-based Learning model accompanied by the VARK Approach can improve creative thinking in the learning style of students.

The first stage of the Problem-based Learning model, namely problem orientation. At this stage, the VARK learning style that plays a role is visual, auditory, and read-write. The visual learning style is facilitated by the image in the student worksheet, the auditory learning style is facilitated by the video link in the student worksheet and the read-write learning style is facilitated by the activity of recording problems and solutions found by students in the form of a mind map from video or image impressions. Learning activities by presenting problems through videos and images at the beginning of learning can bring up creative ideas for finding solutions. In contrast to control classes that have not been facilitated learning styles in student worksheets.

Students who have visual and auditory learning styles are more dependent on the senses of sight and hearing in the learning process (Jannah & Bharata, 2020). Research by Muharrima, (2021) shows that learning using audio-visual simulations can help students in understanding the concept of the material so they can come up with creative ideas. Starting from the emergence of creative ideas, it will produce relevant ideas by being obtained from various points of view (flexibility) in solving problems scientifically, so that it will train the creative thinking skills possessed by students. Liliawati, (2011) also adds that creative thinking skills can help bring out and develop new ideas, which are the development of previously discovered ideas and also give rise to the skills to solve a problem divergently.

The second stage of the Problem-based Learning model is organizing students to learn. This stage aims to assist students in defining and organizing tasks related to the given problems. At this stage, the VARK learning style that plays a role is read-write. The read-write learning style is facilitated by the existence of articles provided by

lecturers. This is because students learn by taking notes and reading what is listened to and obtained from the surrounding environment, such as pouring writing in the form of notes in the form of tables or mind maps from the results of articles that have been read by students. The read-write learning style is part of the visual but more of a written verbal discussion (Nengsih et al., 2021) with the role of the read-write learning style, it is easier to understand the material through reading or writing, by reading students can also find solution ideas from scientific literature, and record important things from the literature so that they can come up with creative ideas. Starting from the emergence of creative ideas, students can solve problems more than just accumulating knowledge, namely by developing cognitive strategies that help students analyze unstructured situations to produce the best solution (Sani, 2014).

The third stage of the Problem-based Learning model is guiding the investigation group. This stage aims to encourage students to collect correct and appropriate information in conducting experiments and looking for explanations about solutions. At this stage, the VARK learning style plays a role, namely the auditor. Auditory learning styles are facilitated by learning in discussions with groups to find solutions to problems provided in the students' worksheets. In this activity, students learn in groups for this because students learn in groups to be able to solve problems by finding various kinds of solutions and answers (fluency), as well as students who use an auditory learning style, are very dependent on hearing captured during the learning process, by listening to what students say they can understand. This can bring up creative ideas owned by students, therefore students can complete with various methods of completion (flexibility) (Musaidah et al., 2020). Based on the results of the study Haslinda et al. (2020) about the influence of the use of creative problem solving on creativity can prove, that it is useful for finding and finding new ideas, to produce a work that is useful for problem-solving. Creative thinking is illustrated as a thought process that involves a variety of ideas and then choosing the most useful, most effective idea to overcome a problem (Yaqoob, 2012).

The fourth stage of the Problem-based Learning model, namely developing and presenting the results of the work. This stage aims to test the level of student creativity in preparing works that is following the ideas that have been compiled in the previous stage. At this stage, the VARK learning style plays a role in visual, auditory-aural, and kinesthetic forms. Auditory-aural and kinesthetic learning styles are facilitated by learning activities

in worksheets that require discussions to produce projects or works in the form of videos and scientific articles, from the results of students carrying out hydroponic practice activities independently, as well as other activities that involve student practical activities by selecting and bringing plants with different types of plant motion in each group for motion material in plants.

Lecturers provide learning activities by discussing to produce work so that there is a process of listening and speaking during the learning process. If students hear and understand the things referred to in the discussion process, then students can apply it by making work and presenting the work well on the practice that has been done independently by students, so that they can develop and present good work based on creative ideas or ideas that have been found. Research results from Pan et al. (2018) state that presenting a work requires the delivery of information that is convincing and easy to understand. This will be directly related to creative thinking that has been composed to prepare relevant material, including reason, and a trustworthy level of originality (elaboration), as an auditory-aural learning style in communicating the presence of the work. These activities can indirectly train students' creative thinking skills (Wilcox et al., 2017).

The fifth stage of the Problem-based Learning model is to analyze and evaluate the problem-solving process. This stage aims to assist students in reflecting on or evaluating the results of their investigations, as well as the learning process that has been carried out. At this stage, the VARK learning style plays a role in the form of auditory-aural and read-write. Auditory-aural and read-write learning styles are facilitated by student activities by providing opportunities to analyze and evaluate. In this opportunity, students can analyze problem-solving solutions in the form of notes written in the student worksheet to convey an evaluation of the results of discussions and notes that have been written in the student worksheet about the ideas that have been found, so that it can train creative thinking skills. Research results Sitorus & Masrayati, (2016) explained that if students want to improve their creative thinking skills, they need to communicate with other people who have high knowledge, ideas, and creativity, so that students can produce a work, and explain the work well.

Students' creative thinking skills can be improved because the learning process has been assisted by teaching materials, namely, MFIs, which present an image, and video and in the learning

process there are direct practical activities, so this can facilitate the learning style VARK owned by students. Existence of this, students can solve a problem with creative ideas or ideas owned by students who are still based on the theory of Plant Physiology about the material "Growth and Development".

D. Conclusion

Based on the results of the data analysis and discussion above, this research can be concluded that the problem-based learning model with a VARK (Visual, Auditory, Read-write, and Kinesthetic) approach affects the creative thinking skills of biology students. The problem-based learning model with the VARK approach can be used by educators to support active learning activities and focus on scientific activities so that students produce creative ideas in problem-solving. The learning process that is following the learning style owned by students, can improve students' creative thinking skills. Based on the conclusions of the research results, it is necessary to submit the following suggestions: 1) Educators or other researchers who want to apply the PBL learning model with a VARK approach to carry out the learning stages in orderly and consistent manner so that the benefits obtained by students can be optimal; 2) This research is limited to one university and one level of the same, for which subsequent research can develop research using different samples and various levels; 3) This research is also limited to students' creative thinking skills, for this reason, further research can be carried out by implementing the PBL learning model with a VARK approach to other 21st century skills, which serves to find out learning models that have great potential, helping students with the low academic ability to empower 21st century skills.

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