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Profile of Student Ability in Creative Problem Solving in Biotechnology Concepts

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Abstract

Biotechnology is a concept in learning that contains many problems related to everyday life. The problem of biotechnology also continues to grow with the times. In every development, biotechnology certainly encounters problems that must be found to solve the problem and of course require the ability to think creatively. So, in biotechnology it is necessary to have creative problem solving abilities to find solutions to every problem. The purpose of this study was to describe the profile of students' abilities in creative problem solving on the concept of biotechnology. This study uses a descriptive method with a qualitative approach. Students will be categorized based on five levels of creativity, namely very creative, creative, quite creative, less creative, and not creative. This category is determined based on a hypothetical theory that has been prepared before the research is carried out. After conducting a research on the profile of students' abilities in creative problem solving on the concept of biotechnology to several students of the Biology Education Study Program, Faculty of Teacher Training and Education, Lambung Mangkurat University who had completed the introductory biotechnology course, the results obtained four levels of creativity, namely very creative, creative, moderate creative and less creative. Meanwhile, students who are not creative are not found in this study.

Abstrak

Bioteknologi merupakan suatu konsep dalam pembelajaran yang berisi banyak permasalahan yang berkaitan dengan kehidupan sehari-hari. Permasalahan bioteknologi tersebut juga terus berkembang mengikuti perkembangan zaman. Setiap perkembangannya, bioteknologi tentu menemui permasalahan yang harus ditemukan penyelesaian masalahnya dan tentunya memerlukan kemampuan berpikir kreatif. Sehingga, dalam bioteknologi perlu adanya kemampuan penyelesaian masalah yang bersifat kreatif untuk mencari solusi setiap permasalahan. Tujuan Penelitian ini adalah untuk mendeskripsikan profil kemampuan mahasiswa dalam penyelesaian masalah secara kreatif pada konsep bioteknologi. Penelitian ini menggunakan metode deskriptif dengan pendekatan kualitatif. Mahasiswa akan dikategorikan berdasarkan lima tingkatan kreativitas yaitu sangat kreatif, kreatif, cukup kreatif, kurang kreatif, dan tidak kreatif. Kategori ini ditentukan berdasarkan teori hipotetik yang telah disusun sebelum penelitian dilaksanakan. Setelah dilaksanakan penelitian profil kemampuan mahasiswa dalam penyelesaian masalah secara kreatif pada konsep bioteknologi terhadap beberapa mahasiswa Program Studi Pendidikan Biologi, Fakultas Keguruan dan Ilmu Pendidikan, Universitas Lambung Mangkurat yang telah menyelesaikan mata kuliah pengantar bioteknologi didapatkan hasil empat tingkatan kreativitas yaitu sangat kreatif, kreatif, cukup kreatif, dan kurang kreatif. Sedangkan untuk mahasiswa yang tidak kreatif tidak ditemukan dalam penelitian ini.

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A. Introduction

The National Education System explains the obligation of an educator to create an educational atmosphere that is meaningful, fun, creative, dynamic, and dialogical. However, based on the existing findings, learning is generally limited to verbal reasoning and logical thinking, on tasks that only require convergent thinking, namely thinking towards a single answer so that it causes less meaning in learning (Munandar, 2014).

Furthermore Munandar (2014), suggests the reasons why creativity in students needs to be developed. First, by being creative people can manifest themselves (Self Actualization). Second, the development of creativity, especially in formal education, is still inadequate. Third, being busy creatively is not only beneficial but also satisfying. Fourth, it is creativity that enables humans to improve their quality of life.

Biotechnology learning is currently favored as cutting-edge technology that has the ability to provide answers to various challenges faced by humanity today and in the future, regarding the production of food, medicine, energy and various industrial processes. The many benefits provided by biotechnology, especially for plant breeding, must be in line with people's understanding of the role of biotechnology in everyday life (Maharijaya, 2011). Therefore, biotechnology needs to be introduced in various levels of education so that many people understand the benefits of biotechnology and create creativity in applying biotechnology to make it more useful.

The researcher also obtained an overview of the undergraduate students of the Biology Education program at the University of Lambung Mangkurat Banjarmasin who had programmed introductory biotechnology courses. Based on observations that are most considered in the course of learning in the classroom for students, namely understanding the concept of early learning. If students already have an understanding of the initial concepts of biotechnology courses, students' creative thinking abilities can be seen. In addition, it was also observed that all this time teaching and learning activities in biotechnology courses always target the ability to think creatively, especially when students practice. However, in the learning process, introductory biotechnology courses also have several obstacles, such as limited teaching materials and the absence of a special biotechnology laboratory for practicum so that it is not optimal in bringing up student creativity, especially in practicum. The same problem also occurs at the Cemara Sumenep campus which was stated by Fajarianingtyas (2015) that students are still less active in constructing knowledge and creativity independently in learning biotechnology. This is due to the lack of available biotechnology teaching facilities and materials.

The application of biotechnology concepts will improve students' creative thinking skills. Fitrianto (2016) in his research emphasized that there was an effect of concept application through practicum activities on the ability to think creatively and student learning outcomes in the concept of the human excretion system for class XI at SMA Negeri 15 Kota Tangerang which was in the sufficient category with a percentage of 56.8% and learning outcomes. students in the good category with an average percentage value of 80.1%, an increase compared to before practicum activities.

Biotechnology in its application process will certainly produce both good and bad (side effects), so it will require problem solving to overcome these adverse effects. Problem solving is an activity process to sharpen logic, argue and solve problems and the ability to find out causes, develop alternatives and analyze and choose good solutions. Polya (1985) explains that problem solving is an attempt to find a way out of a difficulty to achieve a goal that can be achieved immediately. Thus, giving students problems to solve can track creative thinking skills well, because to solve problems, one must have creative thinking skills.

Creativity is a person's ability to create new ideas or products that include creative thinking skills, technical, procedural, and intellectual knowledge, as well as motivation (Sudarma, 2013). So, with creativity, problems can be solved. In Nurqolbiah's research (2016), it is stated that in solving problems, creativity is certainly needed, it is proven by the results of his research which show a real difference in the creativity of students whose class is applied to problem-oriented learning. This is in line with Mahmudi (2010) which states that the ability to think creatively does not grow in a vacuum, so it requires facilities. The means in question are problem-solving activities, from the problem-solving activities, students' creative thinking abilities can be seen.

B. Method

This type of research is a descriptive study using a qualitative approach. This study describes the events that are the centre of attention, namely the ability of students to solve problems creatively in the biotechnology concept in a descriptive manner and based on qualitative data. Descriptive research is research conducted to determine the value of independent variables, either one or more variables without making comparisons, or connecting with other variables (Sugiyono, 2014). This research was

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conducted on several Biology Education students at the Lambung Mangkurat University who had finished programming introductory biotechnology courses.

Researcher in this research process acts as the main instrument and written assignments in the form of student worksheets, interview guidelines, and student score lists act as supporting instruments. In this study, after supporting instruments in the form of written assignments, interview guidelines, and a list of student grades, a validation test was carried out until it was declared valid by three validators, namely lecturers from Lambung Mangkurat University. After being valid, a research on the profile of students' abilities in creative problem solving on the concept of biotechnology would be carried out.

The results data from the supporting instruments are categorized based on the hypothetical theory that has been prepared in advance by the researcher and broken down into a list of student scores. So that student data will be obtain based on the level of creativity in solving problems with the concept of biotechnology. After that the data will be analyzed through the stages of data reduction, data presentation, and drawing conclusions.

C. Results and Discussions

Before the research is carried out, the supporting instruments need to be validated by experts to determine their feasibility. Septiani (2020) states that validation of the product being developed is important because this validation aims to obtain value and feasibility from experts. After being declared valid, this instrument is ready for use in research but still has to be revised according to the validator's suggestion. Murdiyanti (2021) stated that even though the product has been declared very valid or effective, it must still be corrected according to the validator's suggestion.

Table 1. Written Assignment Results (Student Worksheet) Very Creative Category (NSA Students)

Stages of Problem Solving	Creative Thinking Indicator	Written Assignments			Description of Reason
		I	II	III	
Under-standing the Problem	Fluency	√	√	√	The NSA is able to raise issues according to discourse
	Flexibility	√	√	√	The NSA was able to raise issues from multiple points of view
	Novelty	-	-	√	The NSA is able to bring up problems that are new or different from other students in TT III
Develop a problem-solving plan	Fluency	√	√	√	The NSA was able to develop problem-solving plans
	Flexibility	√	√	-	The NSA was able to formulate a problem-solving plan from several perspectives on TT I and II
	Novelty	√	√	√	The NSA is able to come up with problem-solving plans that are new or different from other students
Carry out a problem-solving plan	Fluency	√	√	√	The NSA is able to outline problem solving steps
	Flexibility	√	√	√	The NSA is capable of problem-solving measures from multiple points of view
	Novelty	√	√	√	The NSA is capable of problem-solving steps that are new or different from other students
Re-check the results of solving the problem	Fluency	√	√	√	The NSA is able to suggest impacts (positive and negative) and solutions to the problem-solving process
	Flexibility	√	√	√	The NSA is able to articulate the impacts (positive and negative) and solutions of the problem-solving process from multiple perspectives
	Novelty	√	√	√	The NSA is able to suggest impacts (positive and negative) and solutions to the problem-solving process that are new or different from other students

Description: sign (√) means that the indicator is fulfilled

After conducting the research using written assignment support instruments in the form of valid student worksheets to several students who were the research subjects. According to Suyidno (2019), indicators that are used as an assessment in measuring creativity are the aspects of fluency, flexibility aspects and novelty aspects. Meanwhile, the stages of solving the problem according to Polya (1985) understand the problem, compiling a problem-solving plan, implementing a problem-solving plan, and re-examining the results of problem solving. The result is that there are four levels of student creativity in solving biotechnological concept problems. These levels are very creative, creative, quite creative, and less creative. The following is the profile data of students' abilities in creative problem solving on the concept of biotechnology for each level are presented in tables 1 to 4.

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Based on the table above, NSA students have a very creative category based on the results of their answers on written assignments I to III. Based on the hypothetical theory that has been prepared previously, if students meet 10-12 indicators of the 12 available indicators, then students can be categorized as very creative.

NSA students actually fulfill almost all existing criteria. The NSA fulfills 11 indicators on all written assignments. In written assignments I and II, the indicators that were not fulfilled by the NSA were only on the novelty aspect at the stage of understanding the problem. This is because the answers or problems put forward by the NSA are the same as those of other students so that new or different elements are not fulfilled or in other words the probability is high. Whereas in written assignment III, the indicators that were not fulfilled were only on the flexibility aspect at the stage of preparing a problem solving plan because the NSA's answer was only from one point of view, namely about "the process of raising transgenic animals only". Antika (2019) explains that individuals who have high or very creative creativity are individuals who can express their opinions smoothly and accurately, can express opinions that come from their own thoughts or they can be new things that others have not thought of, have high imaginative power, able to provide solutions to the problems he finds, and so on.

Table 2. Written Assignment Results (Student Worksheets) Creative Category (NAI Students)

Stages of Problem Solving	Creative Thinking Indicator	Written Assignments			Description of Reason
		I	II	III	
Under-standing the Problem	Fluency	√	√	√	NAI is able to raise problems according to discourse
	Flexibility	-	√	√	NAI was able to raise problems from various points of view in TT II and III
	Novelty	-	-	-	NAI was unable to raise problems that were new or different from other students
Develop a problem-solving plan	Fluency	√	√	√	NAI is able to develop a problem-solving plan
	Flexibility	-	-	-	The NAI was unable to formulate a problem-solving plan from several points of view
	Novelty	√	√	√	NAI is able to come up with a problem solving plan that is new or different from other students
Carry out a problem-solving plan	Fluency	√	√	√	NAI is able to describe steps to solve the problem
	Flexibility	√	-	-	NAI was able to solve problems from various points of view only on TT I
	Novelty	√	√	√	NAI is able to solve problems that are new or different from other students
Re-check the results of solving the problem	Fluency	√	√	√	NAI is able to present impacts (positive and negative) as well as solutions to the problem solving process
	Flexibility	-	-	-	NAI is unable to present impacts (positive and negative) and solutions to the problem-solving process from various perspectives
	Novelty	√	√	√	NAI is able to present impacts (positive and negative) and solutions to the problem-solving process that are new or different from other students

Description: sign (√) means that the indicator is fulfilled

Based on the table above, NAI students have a creative category based on the results of their answers in written assignments I to III. Based on the hypothetical theory that has been prepared previously, if students meet 7-9 indicators of the 12 available indicators, then students can be categorized as creative.

In the written assignment I carried out by the NRA, flexibility and novelty indicators at the stage of understanding the problem were not fulfilled because the NRA's answer was only from one point of view, namely about "there is no testing about fermentation products" and the answer was also the same as for several other students. In addition, NAI was also unable to meet flexibility indicators at the stage of preparing a problem-solving plan because NAI's answer was only related to "studying the fermentation process". The last aspect that is not fulfilled is flexibility on the stage of re-examining the results of problem solving because it only puts forward one impact and one solution.

In written assignments II and III, NAI has uniform unfulfilled indicators, namely noventy aspects at the stage of understanding the problem because the answer is the same as other students, flexibility aspects at the stages of compiling, implementing, and re-examining the problem solving plan because the NAI answer only presents one point of view. namely the scientific field only. Antika (2019) explains that an individual with a moderate level of creativity can actually be said that the individual actually already has creativity in

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himself, but the creativity of the individual has not developed / is not optimally developed so that sometimes it appears sometimes it doesn't. Individuals like this only need more intense training and treatment to develop their creativity.

Table 3. Written Assignment Results (Student Worksheet) Quite Creative Category (Student NRS)

Stages of Problem Solving	Creative Thinking Indicator	Written Assignments			Description of Reason
		I	II	III	
Under-standing the Problem	Fluency	√	√	√	NRS is able to raise problems according to discourse
	Flexibility	-	-	-	NRS is unable to address problems from multiple points of view
	Novelty	-	-	-	NRS was unable to bring up problems that were new or different from other students
Develop a problem-solving plan	Fluency	√	√	√	NRS is able to compile a problem solving plan
	Flexibility	-	-	-	NRS was unable to develop a problem-solving plan from several perspectives
	Novelty	-	-	-	NRS was unable to come up with a problem solving plan that was new or different from other students
Carry out a problem-solving plan	Fluency	√	-	-	NRS was able to describe problem solving steps only in TT I
	Flexibility	-	-	-	NRS is incapable of problem-solving steps from multiple points of view
	Novelty	-	-	-	NRS is not capable of problem-solving steps that are new or different from other students
Re-check the results of solving the problem	Fluency	√	√	√	NRS is able to suggest impacts (positive and negative) as well as solutions to the problem solving process
	Flexibility	-	√	√	NRS is able to present impacts (positive and negative) and solutions to the problem solving process from various perspectives in TT II and III
	Novelty	√	√	√	NRS is able to suggest impacts (positive and negative) as well as solutions to the problem-solving process that are new or different from other students

Description: sign (√) means that the indicator is fulfilled

Table 4. Written Assignment Results (Student Worksheet) Less Creative Category (ASI Students)

Stages of Problem Solving	Creative Thinking Indicator	Written Assignments			Description of Reason
		I	II	III	
Under-standing the Problem	Fluency	√	√	√	ASI is able to raise problems according to discourse
	Flexibility	-	-	-	ASI is unable to address problems from multiple points of view
	Novelty	-	-	-	ASI is not able to bring up problems that are new or different from other students
Develop a problem-solving plan	Fluency	√	√	√	ASI is able to formulate a problem-solving plan
	Flexibility	-	-	-	ASI is unable to develop a problem-solving plan from several points of view
	Novelty	-	-	-	ASI is not able to come up with a problem solving plan that is new or different from other students
Carry out a problem-solving plan	Fluency	√	√	√	ASI is able to describe steps to solve the problem
	Flexibility	-	-	-	ASI is not capable of problem-solving steps from multiple points of view
	Novelty	-	-	-	ASI is not capable of problem-solving steps that are new or different from other students
Re-check the results of solving the problem	Fluency	-	-	-	ASI is not able to convey the impact (positive and negative) as well as solutions to the problem solving process
	Flexibility	-	-	-	ASI is not able to convey the impact (positive and negative) and solutions of the problem solving process from various perspectives
	Novelty	-	-	-	ASI is not able to present impacts (positive and negative) and solutions to the problem-solving process that are new or different from other students

Description: sign (√) means that the indicator is fulfilled

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Based on the table 3 above, NRS students have a fairly creative category based on the results of their answers in written assignments I to III. Based on the hypothetical theory that has been prepared previously, if students meet 4-6 indicators from the 12 available indicators, then students can be categorized as quite creative.

The answers of NRS students only fulfilled the 5 available indicators and only the fluency aspect at all stages of problem solving were fulfilled, meaning that NRS was only able to state general answers and was unable to state new answers and from several points of view. Even in written assignments II and III NRS was not able to describe the steps to solve the right problem. Only at the rechecking stage of problem solving NRS tends to have answers that meet all the existing aspects, because at this stage the NRS answers tend to be complete, have various points of view, and differ from the answers of other students. According to Antika (2019) individuals who have a sufficient or low level of creativity mean that the individual has not reached an ideal level of creativity. This means that the individual still tends to be passive in the learning process itself.

Based on the table 4 above, ASI students have a less creative category based on the results of their answers in written assignments I to III. Based on the hypothetical theory that has been prepared previously, if students meet 1-3 indicators of the 12 available indicators, then students can be categorized as less creative.

ASI students are only able to fulfill each of the 3 indicators in each written assignment, namely the fluency aspect at the stage of understanding the problem, compiling a problem-solving plan, and implementing a problem-solving plan. ASI's answer is only able to say one answer without any variation in the perspective of the answer, and of course the answer is the same as other friends or is general in nature. Even at the stage of re-examining the results of solving the problem of breastfeeding, he was unable or incomplete to mention the impact and solutions of the solutions he put forward.

The results of this study indicate the diversity of student creativity, especially those related to biotechnology learning. To increase creativity in biotechnology learning, it is necessary to have supporting facilities and environmental conditions. Fitriansyah (2018) states that student creativity will emerge if learning is adjusted to the potential or circumstances of each in the student's environment. In addition, to increase the creativity of students in learning biotechnology, direct application is needed and it will be implemented if the infrastructure is adequate. Irwandi & Hery (2019) state that learning that can be applied directly will feel more meaningful for an individual and of course can increase the individual's creativity.

D. Conclution

After conducting research on the profile of students' ability in creative problem solving on the concept of biotechnology to several students of the Biology Education Study Program, Faculty of Teacher Training and Education, Lambung Mangkurat University who had finished programming introductory biotechnology courses. The results showed that there were four levels of creativity that were found, namely very creative, creative, quite creative, and less creative. Meanwhile, students who are not creative are not found in this study.

This research still has shortcomings in aspects such as the research time span that is too short. The next research should be able to choose the right time, for example when the condition of the student as a subject is not busy, so that the filling of the written assignment can be optimal.

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