Universitas Muhammadiyah Malang, East Java, Indonesia

JPBI (Jurnal Pendidikan Biologi Indonesia)

p-ISSN 2442-3750, e-ISSN 2537-6204 // Vol. 7 No. 2 July 2021, pp. 111-116

Research Article

Analysis of students' creative thinking skills on Plant Microtechnique laboratory practices

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ARTICLE INFO

Article history
Received: 29 May 2020
Revised: 18 May 2021
Accepted: 03 June 2021
Published: 27 July 2021

Keywords
21st-Century skills
Laboratory practices
Practical activities
Thinking skills

ABSTRACT

Empowerment of creative thinking skills is important in every lecture activity, including practicum. This study aimed to analyze students' creative thinking skills in Plant Microtechnique practicum. This research used descriptive method in which the participants were the seventh semester biology education students (*n*=20) of State University of South Sumatera, Indonesia. The student has taken Plant Microtechnique Course in the previous semester. The instrument used was essay test developed based on creative thinking indicator. The data were processed by calculating the percentage for each indicator and categorized into three levels (i.e., low, medium, and high). The findings revealed that students' creative thinking skills in Plant Microtechnique laboratory practices were medium for fluency indicator, and low for flexibility, originality, and elaboration indicators. Therefore, it is necessary to revise learning strategies that support the empowerment of students' creative thinking in Microtechnique Laboratory practices.

How to cite: Ermayanti, E., Anwar, Y., & Santri, D. J. (2021). Analysis of students' creative thinking on Plant Microtechnique laboratory practices. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 7(2), 111-116. doi: https://doi.org/10.22219/jpbi.v7i2.12321

INTRODUCTION

An understanding of anatomy is needed to study the structure of organisms (Yeung et al., 2015). Furthermore, by studying plant anatomy, students can understand the structure of cells, tissues, seeds, and plant organs (Crang et al., 2018; Ermayanti et al., 2017). In fact, plant anatomy is considered the heart of botany (Sokoloff et al., 2021). To study it all, the use of a microscope and the manufacture of slides is very necessary because it is used as a tool to observe plant structures in more detail (Koehler et al., 2020; Simpson, 2019; Timmers, 2016). In this regard, various techniques have been used to make slides for studying plant structures (Yeung et al., 2015). In the biology education study program, Stated University in South Sumatra, the knowledge of techniques for observing plant tissue structures is given through Plant Microtechnique courses.

The Plant Microtechnique course contain a variety of topics, from basic concept of Plant Microtechnique until maceration methods and preparation of pollen slides. Demands of this course required a student to make a microscopic incision of plant tissue in different methods sections and observe it using a microscope. The students must integrate their knowledge about the anatomical of plants that have been obtained from a previous course. Students are also required to have an extensive insight and skillfully designing, implementing and managing laboratory activities. This experimented experience is expected to serve as a provision for students in drafting the final task proposal plan for undergraduate education. This course should be trained and develop students' creative thinking skills.

Empowering creative thinking skills in students is a very important thing in the current condition. Creative thinking skills allow students to apply their ability to generate ideas, questions, hypotheses and experimenting with different alternatives to solve various problems (Kuo & Hwang, 2014; Runisah et al., 2016). With creative thinking skills, student can solve several complex problems (Birgili, 2015; Kuo & Hwang, 2014). Besides, previous research provides evidence that creative thinking skills are very important in various domains as well as in daily life (Chiu & Salustri, 2010; Runisah et al., 2016; Tekic et al., 2015; Ülger, 2018). Therefore, the ability to think creatively is very important to be trained in students. The teacher must provide assignments that facilitate student to improve their creative thinking skills.

Several studies have examined students' creative thinking skills. Some of them try to examine the effect of several innovative learning models on these thinking skills, such as research-based learning model (Nursofah et al., 2018) and problem-based learning (Birgili, 2015; Talat & Chaudhry, 2014). The other research was assessed the effect of web-based creative thinking teaching on students' creativity (Lin & Wu, 2016). Another study tried to evaluate the factor that contributed to student creativity (Jia et al., 2019). However, the research that try to examine or to analyze students' creative thinking skills in Plant Microtechnique course is still rare to be carried out. So, the aimed of this study was to describe students' creative thinking skills and explain the constraints in Plant Microtechnique learning. This study need to be conducted because the study will provide a lot of useful information, including how to improve students' creative thinking skills in laboratory practice. The information and data obtained from this study can be used as a basis for designing practical learning innovations in the laboratory to develop student creativity. Besides, this research provides information in practicing one of the 21st-century skills in the learning process in the laboratory.

METHOD

This study used descriptive method. This study was conducted in Biology Education Program, State University in South Sumatera from March to June 2019. The participants of the research were the 7th-semester biology education student (n=20: Female 17 and male 3) who was takes Plant Microtechnique courses in the previous semester (Table 1).

Table 1. Distribution of students based on social background

Demography	Descriptive	Frequency	Percentage (%)
Gender	Male	3	15
	Female	17	85
Age	21 - 22 years	4	20
	19 - 20 years	16	80
	17-18 years	0	0
Academic value	3.6 - 4.0	5	25
	3.0 – 3.5	12	60
	2.5 – 2.9	3	15

The instruments used in this study were creative thinking instrument test (essay test) with fourth indicator namely: sensitivity, fluency, flexibility and elaboration. This instrument test was developed based on creative thinking indicator (Al-sulaiman, 2009). Before being used as a research instrument, the test questions were tested with students who had finished the Plant Microtechnique course. Then, the validity of the instrument test was analyzed using Pearson's Product Moment Correlation to determine the validity of each item. Meanwhile, to analyze the reliability of the instrument, Cronbach's alpha test was conducted. The results, all the questions used were valid and the reliability of the instrument was 0.493 (moderate category).

Beside essay test, observation guidelines, questionnaires and personal communication guidelines also have been developed. Personal communication and observation were used to get information about the learning process of Plant Microtechnique. On the other hand, students' opinion about the learning process was collected using Questioner. The Information to be obtained namely: (i) Model of practicum guidelines; (ii) the role of students during practicum activities; (iii) student interest in Plant Microtechnique courses; (iv), constraints in practicum activities (v) practicum assignments. The data of creative thinking skills were analyzed with central tendency and dispersion analysis. Data were processed by calculating the percentage (%) for each indicator and categorized into three levels (low, medium and high). This category was adapted and modified from Putra et al. (2018) and Arikunto (2013) (Table 2).

Table 2. Categorized of students creative thinking skills in Plant Microtechnique laboratory practices

Value	Criteria
68-100	High
33-67	Medium
<33	Low

RESULTS AND DISCUSSION

The findings revealed that students' creative thinking skill in Plant Microtechnique laboratory practices were still low in flexibility, originality, and elaboration indicators. Detail of student creative thinking skill in each aspect can be seen in Table 3. According Table 3, it was known that student creative thinking skill were in medium and low category. The highest score was in fluency indicator (medium category) and the lowest score was in flexibility indicator (low category). Based on the analysis of student answers, in the fluency aspect, students have not been able to correctly formulate the titles, objectives, and procedures for practicum. In the flexibility aspect, students have low ability in created representations of plant tissue. Meanwhile, in the elaboration aspect, students generally cannot analyse data correctly according to the concept. The data presented by students was also not based on correct theoretical. This causes the low average in the elaboration aspect (30.00). The results of the analysis of students' creative thinking abilities showed that students with high academic abilities (3.5 - 4.0) had better creative thinking skills than others. Meanwhile, there was no difference between the creative thinking abilities of the male and female student. In general, this data show that the learning process was not facilitated students to develop creative thinking skills. According to observation, questionnaire and personal communication to the students, some of the problems that were considered as causes of student creative thinking skills.

Table 3. Score of students' creative thinking skills on Plant Microtechnique laboratory practices

Aspect	Mean	Criteria	*SD*
Fluency	40.00	medium	5.77
Flexibility	25.55	low	4.41
Originality	26.03	low	3.91
Elaboration	30.00	low	5.21

According to the observation, students were not directly involved in learning activity, especially in laboratory activities such as formulating titles, problems, objectives, hypotheses, determining tools and materials and work procedures. Students just receive the lesson from the teacher. This condition will not develop student laboratory practice skills. In fact, quality of learning is very important in education, where student is involved in learning activity so impact to the learning outcomes (Nursofah et al., 2018). But, in this study, students only followed the instructions in the laboratory practice guidelines. Students were not trained in terms of practicum planning skills. Laboratory practices guidelines form cookbook model causes the learning process cannot foster students' creativity. It is also supported by the theory that student's involvement in learning process and learn with understanding will develop their knowledge to solve complex problems and their creative thinking skills (Runisah et al., 2016).

The implementation of laboratory activities was conducted in several phases: (a) explanation at the beginning of laboratory activities; (b) the implementation of laboratory activities in groups; (c) class presentations and group discussions; (d) collection of reports. This condition causes students didn't prepared themselves before laboratory activities. This is in accordance with students' response that shows 85% students did not read laboratory practice guidelines at home. In addition, only 5% of students can perform laboratory activities without having to see the laboratory practice guidelines. Based on personal communication, it is known that students do not read the practicum guide previously because there will be an explanation from the lecturer at the beginning of the practicum activity.

Furthermore, inadequate laboratory practices were also observed in this study. This situation led to a limited time for the lecturer to conduct discussions at the end of laboratory activities. It is also expressed by other researchers that students' reports are not performed optimally because of insufficient time in laboratory practices (Hofstein & Lunetta, 2003). Moreover, many students suggest that the practical instructions were not easy to understand. The student response laboratory practices guidelines showed that the laboratory practices guidelines help the students in practice (75%), but the questions in the laboratory practices guidelines do not help students to solve the problems (90%).

The findings of this study indicated that the learning process that were used in Plant Microtechnique laboratory practice was not relevant to improve creative thinking. The Plant Microtechnique course has not fully empower students' creative thinking skills, especially on the flexibility, originality, and elaboration aspects. In flexibility aspect, the students have not been able to describe and represent the characteristics of plant tissues in 2D, 3D or verbal forms accurately. In the aspect of originality, students were hard to arranging tools and materials as well as working steps in the laboratory practice related to the problems. Meanwhile, in the elaboration aspect, students are hard to argue related to solving the problems based on theoretical studies.

The previous studies indicated that aspects in creative thinking can be enhanced and developed by training (Zhou, 2012). Therefore, to improve and develop creativity and students' creative problem solving in Plant Microtechnique laboratory practices, it is necessary to apply the instructional strategies that can stimulate and motivate students to be creative and actively use their knowledge in solve the complex problem. Learners need to apply their ability to generating idea and different alternatives to solve complex problem. Furthermore, the students should be directly involved in formulating objectives, structuring tools and materials, designing workings as well as create the results of a microscopic observation in a different form.

Empowerment of creative thinking skills must be a concern for all educators (Ülger, 2018), including educators in universities. The reason, creative thinking skills include four skills in the 4C framework that must be possessed by society in the 21st Century. These skills also include higher-order thinking skills that can be the capital of students to face competition in today's era (Wall, 2015). Through creative thinking skills, they will easily adapt to a changing environment. In addition, they will be able to solve various problems that they will face in the future (Thuneberg et al., 2018).

In connection with the importance of empowering creative thinking skills, microteaching lectures must be designed to be innovative learning-based lectures. Several learning models that can be used as references in empowering creative thinking skills are project-based learning (Antika & Nawawi, 2017; Putri et al., 2019; Wijayati et al., 2019; Yamin et al., 2020) and problem-based learning models (Birgili, 2015; Kardoyo et al., 2020; Khoiriyah & Husamah, 2018; Talat & Chaudhry, 2014; Zhou, 2012). Lecturers can raise problems before the Plant Microtechnique lecture begins. Lecturers can also direct students to create works from projects instructed by lecturers. This course design will also improve students' learning outcome (Ermayanti et al., 2020). In addition to the two learning models, Plant Microtechnique lecturers can also apply authentic inquiry learning. In this kind of learning, students are more trained to be able to strengthen their scientific skills because they are facilitated to carry out practical work like research conducted by real researchers (Waight & Abd-El-Khalick, 2011). This learning has also been reported to be able to improve student competence (Fernandez, 2017).

CONCLUSION

Research results show that students' creative thinking on Plant Microtechnique laboratory practices are not in accordance with the expected. Students' creative thinking skills are still in medium and low category. The findings also revealed that the learning process was not relevant to improve creative thinking in Plant Microtechnique laboratory practices. Some of the obstacles in the learning of Plant Microtechnique include: (i) the implementation of lectures is dominated by one-way communication; (ii) lectures and practicums guideline do not lead students to improve their creative thinking skills; and (iii) the practicum guide is recipe-based guideline; and (iv) an inadequate of laboratory practices. Therefore, to improve student creative thinking skills, the lecturer must develop the instructional strategies that can stimulate and motivate students to be creative and actively use their knowledge in solve the complex problem related Plant Microtechnique laboratory practices. Given the importance of the ability to think creatively in laboratory activities, the use of appropriate methods is needed to increase student creativity. Furthermore, the studies that involved the students in laboratory activities such as formulating titles, problems, objectives, hypotheses, determining tools and materials, and work procedures are needed.

ACKNOWLEDGEMENT

The authors would like to express gratitude to Universitas Sriwijaya, because this research was financially supported by a research grant (PNBP UNSRI 2019).

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