Analysis of Student Scientific Creativity in Practicum-Based Pharmacognosy Course

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Abstract: Scientific creativity is an important competency in Higher Education, especially in the fields of science and technology. This research aims to analyze the level of scientific creativity of D-III Pharmacy students in practicum-based Pharmacognosy courses. In Torrance's indicators, there are four indicators used to measure the level of scientific creativity of students, namely fluency, flexibility, originality, and elaboration. The research method used is quantitative descriptive method with data collection through observation, and questionnaire forms. The research subjects were 3rd semester (odd) pharmacy D-III study program students with a total of 30 students. The results showed that the level of scientific creativity of students tended to be in the less category. As for the level of student creativity in each Torrance indicator, namely fluency is in the medium category (51%), originality is in the less category (23%), flexibility is in the less category (25%), and elaboration is in the less category (26%).

Keywords: Pharmacognosy; Practicum; Scientific Creativity; Student

Introduction

The development of technology in the 21st century has triggered competition between individual humans (Jannah et al., 2022). The skills that students need to prepare for the 21st century are self-confidence, collaborative thinking, creative thinking, and the ability to apply or transfer knowledge in new situations (Akpur, 2020). Each individual must be able to develop their potential so as not to be left behind by others (Putri et al., 2024). The educational process in schools must be able to help and prepare students to face developments in the current era (Hikmah et al., 2023). Therefore, the development of information technology in the modern era needs to be improve to foster creativity, critical thinking, and skills among students(Wu & Wu, 2020). This has an impact on the world of education which is responsible for producing graduates who are adaptive

and technologically literate (Yanti et al., 2023). The purpose of education is to develop the potential of students to become human beings who are faithful and devoted to God Almighty, have noble character, are healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens (Kusadi et al., 2020).

According to Sheppard, (2022), five essential skills are needed by students in the 21st century, namely critical thinking, communication, creativity, collaboration, and skills. Among these, scientific creativity is a crucial competence (Umam & Jiddiyyah, 2021) that enables students to face global competition in their future careers. Creativity has a meaning, namely the ability to give birth to several new ideas and concepts that have never existed before, so that a prototype is formed based on the results of previous ideas (Fatmawati et al., 2022). Scientific creativity has been

recognized as one of the key learning outcomes in higher education (OECD, 2018), as students are not only expected to master content knowledge but also to design innovative solutions for complex, real-world problems (Sirait et al., 2023; Huang & Wang, 2019).

The development of science and technology in the pharmaceutical field requires students not only to understand basic concepts, but also to be able to think creatively and innovatively, especially in the field of pharmacognosy (Utama et al., 2021). Pharmacognosy is a branch of pharmaceutical science that studies natural resources, especially plants, as basic ingredients for medicines (Wiratma et al., 2020). In this course, students are invited to recognize, research, and develop the potential of natural materials through a systematic scientific approach (Nugroho, 2017).

The increasing demand for medicines derived from natural ingredients, along with Indonesia's rich biodiversity, highlights the growing importance of pharmacognosy (Nurcahyani et al., 2023). Pharmacy students, as future vocational pharmacy personnel (TVF), pharmacists, and researchers, are expected not only to master theoretical knowledge but also to demonstrate scientific creativity in identifying, evaluating, and utilizing natural materials as therapeutic sources. Scientific creativity in this context refers to the ability to generate new ideas, design innovative experiments, and develop effective and efficient methods in pharmacognostic research.

The development of students' scientific creativity often encounters various challenges, including limited facilities, inflexible curriculum, and insufficient support for independent idea exploration (Jang, 2009). Analyzing how scientific creativity evolves in the context of pharmacognosy learning, as well as identifying both supporting and inhibiting factors, becomes an essential step to address these issues.

One response that can be done to support the development of students' scientific creativity is to use practicum-based learning. Practicum is one of the significant ways to increase students' scientific creativity (Gunawan et al., 2017) (Hermansyah et al., 2017). Practicum not only introduces students to empirical experience, but also opens space for exploration, data interpretation, and testing of new ideas. This is consistent with (Widiarini et al., 2024) that learning will be more effective if students are in direct contact with the objects studied and objects in the surrounding environment.

The novelty of this study lies in its specific focus on scientific creativity within pharmacognosy learning. While previous research has broadly examined creativity in science education, there is still limited empirical evidence on how creativity manifests in pharmacognosy courses, particularly in the Indonesian higher education context. This research addresses a gap by examining how practicum-based learning can stimulate students' scientific creativity in exploring natural medicines derived from biodiversity-rich resources such as Indonesia's flora.

The importance of this research is threefold: 1) Pedagogical significance: It provides insights into how practicum activities can be strategically designed to foster higher-order thinking and innovation, aligning with 21st-century learning demands. 2) Pharmaceutical relevance: It contributes to strengthening pharmacognosy education by linking biodiversity-based resources to innovative drug development, which is highly needed in global and national healthcare. 3) Policy and institutional relevance: It supports universities and pharmacy programs in enhancing graduate competencies, ensuring that future pharmacists and researchers are not only knowledgeable but also capable of scientific innovation.

This study analyzes students' scientific creativity in pharmacognosy learning with the aim of is generating practical recommendations for designing learning models that encourage creativity, innovation, and problem-solving in pharmaceutical education.

Method

The research method used in this research is quantitative descriptive method. Quantitative descriptive method is the search for facts with proper interpretation (Makagingge et al., 2019). The subjects of this study were 3rd semester students of the D-III Pharmacy Study Program of Medica Farma Husada Mataram Polytechnic as many as 30 students.

Data collection techniques are described as a series of interrelated activities with the aim of collecting information to answer questions that arise (Irawan et al., 2021). The data collection techniques used in this study are observation methods, interview methods and questionnaires based on Torrance indicators, namely fluency, flexibility, originality, and elaboration (Aryanti et al., 2021; Suryana et al., 2021).

The instruments used in this research were interview guidelines and questionnaire forms. The preparation of interview guidelines aims to make a list of relevant questions so that the interview process runs smoothly. The questionnaire sheet was used to collect data on students' scientific creativity in pharmacognosy courses. Student creativity is assessed by giving a score from 0 to 5 for each sub-indicator on the dimensions of creativity adapted from Torrance. The creativity indicators can be seen in Table 1.

Table 1. Student Creativity Indicator

Indicator	Description
Fluency	Students can provide the right answer to the problem.
Flexibility	Students can use different perspectives in answering existing problems.
Originality	Students can give original answers compared to those given by all students..
Elaboration	Students can provide a clear, detailed, and detailed description and can explain the existing problems logically.

The scoring level of students creativity abilities of each student answers the result can be seen in Table 2.

Table 2. Student Creativity Scoring Rubric

Indikator	Score	Karakteristik
Fluency	0	Student does not respond.
	1	Students are able to explain the answer but not quite right.
	2	Students are able to explain 1 answer correctly.
	3	Students are able to explain 2 answers correctly.
	4	Students are able to explain 3 answers correctly.
	5	Students are able to explain ≥ 4 answers correctly.
Flexibility	0	Student did not respond.
	1	Student gave 1 incorrect opinion in the answer.
	2	Student gave 1 different opinion in the answer.
	3	Student gave 2 different opinions in the answer.
	4	Student gave 3 different opinions in the answer.
	5	Student gave ≥ 4 different opinions in the answer.
Originality	0	Student did not respond
	1	Student is within 20% of answers given by all students.
	2	Student is within 15-20% of answers given by all students.
	3	Student is within 10-15% of answers given by all students.
	4	Student is within 5-10% of answers given by all students.
	5	Student is within 15% of answers given by all students.
Elaboration	0	Students do not respond
	1	Students provide conclusions that are unclear, illogical and almost unrelated to the content of the discussion.
	2	Students provide conclusions that are less relevant or too general, the delivery is not coherent and the logic is weak.
	3	Students provide conclusions that are quite relevant, but the delivery is less clear and the logic is weak.
	4	Students provide relevant, fairly clear and logical conclusions, although there is a slight lack of depth of argument.
	5	Conclusions are very relevant, delivered very clearly and coherently, and supported by strong logic and arguments.

The score of students' scientific creativity is calculated using Formula 1.

$$S = \frac{R}{N} \times 100\% \tag{1}$$

where,
S = Score of student scientific creativity
R = Correct score
N = Maximum score

After obtaining the score of student scientific creativity results, score categories are given to determine the level of student scientific creativity. The category of student ability scores is categorized with a five scale in Table 3 below (Aryanti et al., 2021).

Table 3. Category of students Creativity Level (%)

Percentage (%)	Category
81 - 100	Very Good
61 - 80	Good
41 - 60	Medium
21 - 40	Less
0 - 20	Very Less

Result and Discussion

This research aims to determine the level of scientific creativity of students in practicum-based pharmacognosy courses. In this research, 30 students were studied and carried out in semester 3 (odd). Qualitative data collection in this study was carried out through observation of practicum activities and filling out student scientific creativity questionnaires which included 4 (four) main indicators namely fluency, flexibility, originality, and elaboration. The type of practicum used is expository research, also known as traditional, conventional or verification practicum. Most of the students' practicum activities are based on procedures that have been determined and given by lecturers or instructors. Student learning uses a deductive approach, where students apply general principles to understand certain more specific phenomena.

The level of scientific creativity in this research is measured based on Torrance indicators: fluency, flexibility, originality, and elaboration (Fitri et al., 2023). Each item tested is subdivided based on the scope of indicators of students' scientific creativity abilities on simplisia material. The questions tested are in the form of description questions consisting of 4 (four) items. A description question is a form of written evaluation that requires students to compile answers freely, explain understanding, analysis, and application of material systematically in the form of paragraphs or long descriptions. The description test can encourage students to express opinions and compose in the form of good sentences and provide opportunities for students to express their intentions in their own language and style. The results of the student scientific creativity test are presented in Figure 1.
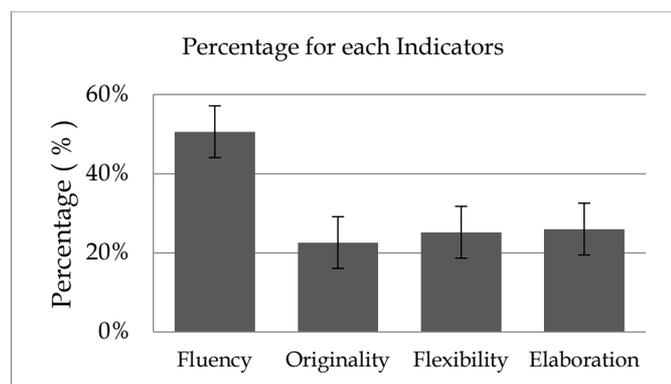

Figure 1. Level of student creativity for each indicator

Based on Figure 1, it is found that students' scientific creativity tends to be high in the fluency indicator, while for the other three indicators it is still quite low. This shows that students actively have the creativity to explore ideas from various points of view, especially in the context of open practicum. The respective percentages for each indicator of student scientific creativity are fluency in the medium category (51%), originality in the less category (23%), flexibility in the less category (25%), and elaboration in the less category (26%).

Fluency

According to Najichah et al., (2024) fluency is the ability to generate ideas or ideas with the characteristics of students being able to come up with many ideas, answers, and ideas. Based on Figure 1, the fluency indicator is already in the medium category, namely 53%, meaning that students are quite capable of answering questions to generate ideas or ideas.

Originality

According to Trisnayanti et al., (2020) originality is the ability to create new ideas in problem solving.

Thinking originality means the ability to express ideas/solve problems in ways that others have never thought of. Based on Figure 1, the level of student creativity to create a new idea is less.

Flexibility

Flexibility is the ability to think of more than one idea in solving problems (Fahmi & Jumadi, 2023). Based on Figure1, students' flexibility ability is only 25%, meaning that students' ability to generate different ideas in solving problems is less.

Elaboration

According to Budi & Izzati, (2021) elaboration is an ability to explain a simple thing to be broader. The results obtained in Figure 1 show that students' ability in the elaboration indicator is less, which is 26%.

The results of student scientific creativity in the fluency indicator have the highest percentage. In this indicator, researchers asked questions related to scientific matters related to simplisia. Students are asked to identify scientific issues related to the problem of simplisia. Based on the results of the answers obtained, some students still cannot come up with ideas related to the problem of simplisia. The above problems are influenced by the use of practicum with an espositiry or traditional model. The more students express ideas, the greater the opportunity for students to develop their ideas.

In this research, the results of scientific creativity of D-III Pharmacy study program students in practicum-based pharmacognosy courses will be presented. The results of student scientific creativity are obtained from the total score based on student answers to the questionnaire questions given. Researchers gave the same four (4) questions to each student. Each item has a minimum value of 0 and a maximum of 5. Based on the acquisition of data through questionnaires, it is found that the level of scientific creativity of students tends to be less. The results of the scientific creativity of D-III Pharmacy study program students in practicum-based pharmacognosy courses are presented in Figure 2.
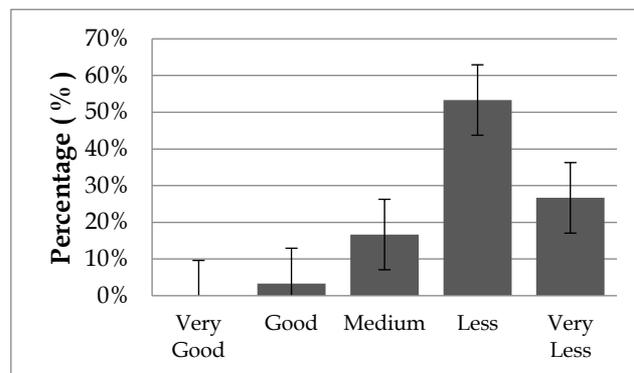

Figure 2. Level of scientific of students

Figure 2 shows that most of the students' creativity abilities are in the medium category, namely 53% of 30 students, while for other categories such as very good only 0%, good category 3%, medium category 17%, and very less category 27%. The lack of student ability in the scientific creativity aspect is influenced by many things. One of the things that has a big influence is the learning model or practicum model with the espository or conventional method. This is in accordance with research conducted by (Mirnawati, 2017) that student creativity is in the medium category when learning using conventional learning models, so it is necessary to use a special learning model to increase student creativity. The learning model that can increase student creativity is project-based learning (PjBL) (Pan et al., 2023; Suprapto et al., 2023). Other research also explains that the project-based learning model can increase students' scientific creativity (Shalihah et al., 2020; Setyarini et al., 2020; Lesmana et al., 2023).

The project-based learning model is a model that can support the implementation of education on the concept of problems and based on experience and real life (Titu, 2015). In addition, the syntax of the project-based learning model can help students optimize their creative and critical thinking patterns by starting learning with essential questions, working together to plan, and depeloping a project completion schedule (Zulyusri et al., 2023). In the implementation of the project-based learning model, students are trained to get ideas in making products and modify them to make them look attractive and useful (Kurniahtunnisa et al., 2023). Students are also trained in utilizing materials around them to be able to produce creative products that can be applied in real life. In research (Mohamadi, 2018) the use of project-based learning model increases students' enthusiasm to make creative things during the learning process.

Conclusion

Based on the results of the research and data analysis process that has been carried out, it shows that the level of scientific creativity of D-III Pharmacy students in semester 3 (odd) in practicum-based pharmacognosy courses is still in the less category. The level of scientific creativity of students in each indicator, namely fluency is in the medium category (51%), originality is in the less category (23%), flexibility is in the less category (25%), and elaboration is in the less category (26%).

Acknowlegments

Conflicts of Interest

The author declares no conflict of interset.

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