



Correlation of creative thinking skill with STEAM readiness of biology pre-service teacher



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ABSTRACT

Creative thinking skills are one of the 21st century skills that must be possessed by biology pre-service teachers. Someone with good creative thinking skills can more easily convey ideas, solve problems, and always think differently than usual. The aim of this study is to know how the relationship between creative thinking skills to STEAM readiness. This research is correlational quantitative research. The sampling technique used in this research is the quota sampling technique. The number of students used as a sample is 90 people with each batch consist of 30 samples. The instrument used in this study is a questionnaire, both to measure creative thinking skills and STEAM readiness. Data analysis techniques using Spearman rank correlation. The data shows the strong correlation between creative thinking skill and STEAM readiness with correlation coefficient value 0,622. The aspects of creative thinking skill are potential to make pre-service teacher more prepared to STEAM implementation at school. The better the creative thinking skills of biology pre-service teacher, the more prepared they will be in implementing STEAM later.

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INTRODUCTION

21st-century education is becoming increasingly complex in the increasing demands of the world of work. This is a challenge for every university to produce graduates who are highly competitive and have competencies that are relevant to the world of work. Teachers are one of the professions that must always be able to adapt to various changing times and technology. Thus, pre-service teachers need to be prepared as well as possible as prospective teacher for the next generations. The competence of 21st-century teacher must be possessed by every pre-service teacher to be able to face various challenges after completing study in higher education. Digital skills, communication, collaboration, problem-solving, critical thinking, and creative thinking must be mature before the student become teacher in schools.

The ability to apply creative thinking in both digital and non-digital environments has become the identity of successful people. According to Gafour & Gafour (2020), creative thinking means observing a situation or problem with a new perspective. Creative thinking in the realm of education is more about how a student applies his imagination in finding solutions for each task given by the teacher (Coughlan, 2007). Creative thinking skills are crucial to have in facing environmental challenges later. Someone with good creative thinking skills will find it easier to find new ideas, solve problems, and have more perspectives on something new (Madyani et al., 2020). These skills will become even more urgent to have considering the current world of education has begun to apply the STEAM approach to learning.

STEAM (Science, Technology, Engineering, Arts, and Mathematics) is a transdisciplinary approach that places priority on the study of science and mathematics with the integration of art, technology, and engineering design (Hall et al., 2020). This approach can facilitate students in problems solving by utilizing their innovation and creativity. STEAM can be an adaptive method in education world to welcoming the 5.0 industrial revolution. On the other hand, teacher must be ready to implement the STEAM approach. As revealed by Albahar & Alammari (2022) that the teachers who participated in the survey regarding readiness for STEAM implementation in the classroom said that they did not have the basic knowledge and skills to do so. Thus, pre-service teachers must be thoroughly prepared and familiarized with the STEAM approach to have readiness when they become teacher later.

There have been many studies related to the importance of STEAM. Likewise, research on the need for someone to have good creative thinking skills in learning and problem solving. Thinking skills are important for students to have as a provision in facing the world of work (Herlina et al, 2018; Madyani et al, 2020). Previous research has also shown that STEAM affects students' creative thinking skills. Fadhilah (2022) reported that there is an increase in students' critical and creative thinking skills through the STEAM learning. However, it has not been studied how the correlation between the creative thinking skills of students (pre-service teachers) and their readiness of STEAM-based education. This is important to study considering that there are still many teachers in the field who are not ready to implement the STEAM approach in their teaching and learning activities. The aim of this study is to find out how the correlation between creative thinking skills and STEAM readiness of biology pre-service teachers.

RESEARCH METHODS

Research Design

This research is correlational quantitative research. This correlational research is used to find the relationship between two variables, namely the independent variable (X) and the dependent variable (Y). In this study, creative thinking skill is variable X while STEAM readiness is variable Y. In addition to looking at the correlation, this study will also look at how strong the correlation is and the direction it's correlation.

Population and Samples

The population in this study were all students majoring in Biology Education, Faculty of Teacher Training and Education, University of Borneo Tarakan with the total number are 318 students. The sampling technique used in this research is the quota sampling technique. The quota sampling technique is a technique for determining a sample from a population that has certain characteristics to the desired number (quota) (Retnawati, 2017). The criteria determined in this study are the samples used are students who have not programmed the thesis (batch of 2019, 2020, and 2021). To meet the number of samples for each stratum, the researcher used her expert

judgment. The number of students used as a sample is 90 people with each batch consist of 30 samples.

Instruments

The instruments used in this study are questionnaires, both to measure creative thinking skills and STEAM readiness. The questionnaire used has gone through the internal validation stage from experts with valid category. The creative thinking skills questionnaire used consists of 4 aspects with a total of 20 statements. The aspects of thinking skills that are measured are fluency, flexibility, originality, and elaboration. While the questionnaire used to measure STEAM Readiness consists of 3 aspects with a total of 15 statements. The aspects of STEAM Readiness that are measured are aspects of knowledge related to STEAM, STEAM opportunities, and STEAM readiness itself. Both types of questionnaires used 1-4 Likert scale.

Procedures

The research procedure consisted of 4 stages, they are preparation, data collection, data analysis, and conclusion. In the preparation stage, the researcher prepares the research instrument that will be used in data collection. Before being used, the instrument is first validated internally by an expert (validator). Furthermore, data collection was carried out by distributing validated questionnaires to all samples via a google form. The questionnaire data that have been obtained are then analyzed statistically and then in the final stage concluded from the study results.

Data Analysis

The data analysis used in this research is inferential statistics in the form of the Spearman rank correlation test. This test was chosen because the type of data obtained in this study was in the form of ordinal data (questionnaire data). Therefore, the correlation test uses Spearman rho (Soesilo, 2018). This correlation test did not pass the normality or homogeneity test. Correlation testing using SPSS version 22 where the value of sig. 2-tailed < 0.05 then it is stated that there is a correlation between the two variables. Meanwhile, the correlation coefficient value can show the strength of the relationship between variables and the direction of the relationship. The following is a correlation coefficient interpretation table to see the strength and direction (+ or -) of the correlation between variables (X and Y).

Table I. Interpretation of Coefficient Correlation Value of X and Y

Coefficient Correlation	Interpretation
0,00 – 0,199	Very Poor
0,20 – 0,399	Poor
0,40 – 0,599	Enough
0,60 – 0,799	Strong
0,80 – 1,00	Very Strong

RESULTS

In the following, statistical test results are presented using the Spearman Rank correlation test on the variables of creative thinking skills and STEAM readiness of biology pre-service teachers.

Based on Table 2, it is known that the value of Sig. (2-tailed) < 0.05 . It can be concluded that there is a correlation between creative thinking skills and STEAM readiness. Furthermore, the Correlation Coefficient of 0.622 indicates a strong relationship between creative thinking skills and STEAM readiness. A positive value on the Correlation Coefficient means that the two variables

have a unidirectional correlation if their creative thinking skills better, so the biology pre-service teacher is more prepared for STEAM implementation.

Table 2. Rank Spearman Correlation of Creative Thinking Skill to STEAM Readiness

			Creative Thinking	STEAM
Spearman's Rho	Creative Thinking	Correlation Coefficient	1.000	.622**
		Sig. (2-tailed)	.	.000
		N	90	90
	STEAM	Correlation Coefficient	.622**	1.000
		Sig. (2-tailed)	.000	.
		N	90	90

DISCUSSION

The Spearman rank correlation test shows a strong relationship between creative thinking skills and STEAM readiness for biology pre-service teachers. Creative thinking skill is crucial for pre-service teachers because it is one of the thinking skills that must have by the 21st-century teachers. As written by Hadinugrahaningsih et al. (2017) that creative thinking skill is part of students' learning and innovation skills in the 21st century. Creative thinking is an ability that leads to needed problem solving (Şenel & Bağceci, 2019). Creativity allows person to find connections, face new challenges, and seek different resolutions than usual. While STEAM is an approach to learning that provides opportunities for students to develop their abilities in their way (Nurfadilah & Siswanto, 2020). The existence of "Arts" in STEAM is one of the factors that cause STEAM to need creativity. Therefore, teacher and pre-service teachers supported by good creative thinking skills will be more ready to apply the STEAM approach in the classroom.

As written in the previous section, there are four aspects of creative thinking skills used in this study, they are fluency, flexibility, originality, and elaboration. Fluency is a skill in generating ideas or answers (Madyani et al., 2020). Fluency will make it easier for someone to answer problems with various solutions or ideas. The current interdisciplinary and multidisciplinary learning complexity (STEAM) requires students to be able to find many solutions to any problem they face. Being able to think divergently and relate concepts to one another will make it easier for them to apply the STEAM approach. STEAM is an approach in the 21st century designed to train students to explore their knowledge, think creatively and analytically (Fadhilah, 2022).

The next aspect is flexibility. Flexibility means a person's ability to see problems from different perspectives to produce varied ideas or solutions. As stated by (Husain et al., 2022), that flexibility allows students to provide various answers to the problem encountered. Can give varied answers will make students more adaptable to issues that require deep thought. More specifically, Rasmawan et al (2022) had explained that the difference between fluency and flexibility is, if fluency is the ability to give answers, then flexibility is the ability to give reasons why they choose the answer. The application of STEAM in biology learning is not only limited to science, but how the concepts of technology, art, and mathematics can used as answers or solutions to problems faced by students. According to (Albahar & Alammari, 2022), teachers feel comfortable integrating STEAM into their concepts and learning activities in the classroom because they train students to be creative in finding various alternative solutions and ideas during learning.

Originality is a person's ability to provide an unusual answer to a problem and can combine previous knowledge in solving problems. Rasmawan et al. (2022) state that the originality aspect means that students not only can provide the correct solution or answer an issue, but also can solves it with innovative or new solutions. In the STEAM approach, students must be able to combine a holistic understanding through the integration of scientific disciplines (Jammie, 2020).

So, if students can connect their past knowledge to construct a new idea, then the integration of scientific disciplines will be easier. The presence of "Arts" (A) in STEAM expects students to be able to think outside of the box (Hanani, 2018). Thus, the originality aspect can lead students to think different than usual.

The last aspect of creative thinking skills is elaboration. Elaboration is the ability to complete and develop the ideas that have been submitted (Pangestu et al., 2021). Elaboration allows students to explain the idea in detail and more interestingly. Learners with good elaboration skills can solve practical problems related to their personal experiences in real-life contexts. This ability will greatly assist biology pre-service teacher students in explaining contextual concepts of biology. Viewed from the STEAM perspective that one field of science can be used to enrich the understanding of other fields of science. According to (Sartono et al., 2020) STEAM approach makes students more familiar with the phenomena that happen around them. Being able to relate a concept to cross-disciplinary science and provide a detailed explanation can show that students are ready to apply the STEAM approach. However, teachers need to always facilitate students to deepen concepts that are useful in practical life (Zephaya et al., 2020).

STEAM implementation is important in 21st-century learning. The existence of the STEAM approach makes learning more meaningful, interesting, and not boring (Suganda et al., 2021). In addition, STEAM had considered facilitating students' integration of their soft skills and hard skills (Wahyuningsih et al., 2020). The STEAM approach has become a concern not only on a national scale but also globally. STEAM provides the teacher with opportunities to develop innovative and challenging teaching practices (Quigley & Herro, 2016). Hall et al. (2020) wrote that the best practice of STEAM is not only to train students' thinking and problem-solving skills, but also to be able to build good personal competencies such as adaptability, communication, and optimism. In its application, STEAM provides flexibility for students to explore and construct their understanding from various disciplines (Halim & Roshayanti, 2021). However, the challenge in implementing this approach is the competence of teachers who must reach the scientific transdisciplinary level, not just multidisciplinary or interdisciplinary (Rahmawati et al., 2019). Thus, prospective teachers need to be prepared as well as possible to face the challenges of the world of education in the future, especially regarding the implementation of the STEAM approach in schools. The role of lecturers in providing information and training skills related to the STEAM approach needs to be further improved so the students have a good perspective on STEAM.

CONCLUSION

The results showed that there was a strong correlation between creative thinking skills and readiness for STEAM implementation with the Correlation Coefficient of 0.622. The Correlation Coefficient shows the significant correlation between the variables. The better the creative thinking skills of biology pre-service teacher, the more prepared they will be in implementing STEAM later.

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APPENDIX I. QUESTIONNAIRE FOR STEAM (*Science, Technology, Engineering, Arts, and Mathematics*) IMPLEMENTATION READINESS

1. I have knowledge of STEAM
Strongly disagree Strongly Agree
2. STEAM can be applied at all levels of education
Strongly disagree Strongly Agree
3. STEAM is relevant to 21st century learning needs
Strongly disagree Strongly Agree
4. I have the ability to implement STEAM in learning process
Strongly disagree Strongly Agree
5. I have knowledge of various learning models/strategies/methods to implement STEAM
Strongly disagree Strongly Agree
6. I have good Self-Efficacy
Strongly disagree Strongly Agree
7. I can create something new in learning with my own ideas
Strongly disagree Strongly Agree
8. I have good problem-solving skills
Strongly disagree Strongly Agree
9. I have good science argumentation skills
Strongly disagree Strongly Agree
10. I have good skills in using digital learning tools
Strongly disagree Strongly Agree
11. I use technology to find lecture/course references
Never Always
12. I take advantages of the latest technology (e.g., the use of software or learning platforms) in making learning media

- Never Always
13. I have a sense of art in assignments given by lecturers (e.g., making video presentations, learning media, project assignments, etc.)
Never Always
14. I have the ability to relate a concept to various disciplines
Strongly disagree Strongly Agree
15. I have the skills to use the equipment in the science laboratory
Strongly disagree Strongly Agree

APPENDIX 2. QUESTIONNAIRE OF CREATIVE THINKING SKILLS

1. I can express ideas, answers, and suggestions in solving problems
1 2 3 4
2. I can work faster and do more than others
1 2 3 4
3. I can present the results of discussions with work from the results of understanding smoothly
1 2 3 4
4. I take note of important things when presenting
1 2 3 4
5. I can explain many ideas about a problem through the work that I submit
1 2 3 4
6. I can implement ideas correctly
1 2 3 4
7. I can present justifiable reasons in reaching a decision
1 2 3 4
8. I can give various ideas
1 2 3 4
9. I can see problems from different perspectives
1 2 3 4
10. I can provide solutions or ideas quickly to a problem
1 2 3 4
11. I can apply concepts, traits, or rules in problem solving examples
1 2 3 4
12. I can present concepts in different ways
1 2 3 4

13. I can answer questions from lecturers during presentations
1 2 3 4
14. I can quickly change my approach to solving a problem
1 2 3 4
15. I can bring up problems, ideas, or things that other people didn't think
1 2 3 4
16. I can create different or completely new ideas or works for the concept of making a product
1 2 3 4
17. I can develop or enrich other people's ideas or respond to my friends' opinions
1 2 3 4
18. I can detail an object, idea, or situation so that it becomes more interesting
1 2 3 4
19. I ask everything related to the material and try to find references from various sources
1 2 3 4
20. I can involve myself in the assignments given by the lecturer
1 2 3 4