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Students' Scientific Attitudes and Creative Thinking Skills

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Abstrak

Salah satu yang dapat mempengaruhi terbangunnya keterampilan berfikir kreatif adalah scientific attitudes seseorang. Tujuan penelitian ini adalah (a) Mendeskripsikan profil scientific attitudes mahasiswa Program Studi Pendidikan matematika, (b) Mendeskripsikan kemampuan berpikir kreatif mahasiswa Program Studi Pendidikan matematika, (c) Menguji keterkaitan antara scientific attitudes dan kemampuan berpikir kreatif mahasiswa. Aspek kelancaran, aspek keaslian dan aspek kerincian termasuk kategori tinggi. Sedangkan aspek keluwesan termasuk pada kategori sedang. Bentuk penelitian menggunakan mixed methods dengan status sepadan yaitu menggunakan pendekatan deskriptif kualitatif dan pendekatan kuantitatif. Sedangkan sampel penelitian adalah mahasiswa yang tidak mengulang pada mata kuliah penilaian proses dan hasil pembelajaran matematika tahun ajaran 2022/2023. Pengambilan sampel menggunakan teknik klaster random sampling. Pengujian hipotesis penelitian dengan menggunakan analisis korelasi Kendall Tau. Hasil pengujian hipotesis menunjukkan bahwa terdapat keterkaitan yang erat antara scientific attitudes dengan kemampuan berfikir kreatif mahasiswa pada perkuliahan penilaian proses dan hasil belajar matematika.

Kata Kunci: analisis korelasi Kendall Tau; kemampuan berfikir kreatif; scientific attitudes.

Abstract

One that can affect the development of creative thinking skills is a person's scientific attitude. The aims of this study were (a) to describe the scientific attitude profile of students in the Mathematics Education Study Program, (b) to describe the creative thinking skills of students in the Mathematics Education Study Program, (c) to test the relationship between scientific attitudes and students' creative thinking skills. Aspects of fluency, aspects of creativity, and aspects of fact are included in the high category. In comparison, the aspect of flexibility is included in the medium category. This form of research uses mixed methods with commensurate status, namely using a qualitative descriptive approach and a quantitative approach. Meanwhile, the research sample was students who did not repeat the mathematics learning process and results in the 2022/2023 school year assessment course. Sampling using cluster random sampling technique. Testing the research hypothesis using Kendall Tau correlation analysis. The results of hypothesis testing show a close relationship between scientific attitudes and students' creative thinking abilities in the process assessment lectures and mathematics learning outcomes.

Keyword: Kendall Tau correlation analysis; creative thinking ability; scientific attitude.

I. INTRODUCTION

4C competencies (critical thinking, creative thinking, collaboration, and communication) are considered crucial in today's digital era. These competencies include the ability to think critically, think creatively, collaborate with others, and communicate well (Afriansyah, 2021; Arsanti et al., 2021; Umam, 2021). One of the educational objectives is to encourage children to think creatively both to solve problems and to communicate or convey their thoughts (Panjaitan & Surya, 2017; Sari & Afriansyah, 2022).

Creative thinking is the ability to observe problems from different angles and from new and different perspectives (Ramalingam et al., 2020). Through creative thinking, students can find new ways to cope with their daily tasks, such as overcoming challenges and solving problems. (Munandar, 1999) argues that creative thinking provides a variety of possible answers based on the given information, with a varied number and emphasis on the appropriateness of the answer. According to (Permata et al., 2022) creative thinking is a process that comprises elements of originality, fluency, flexibility, and proficiency. Creative thinking yields sophisticated thinking. In addition, (Faturohman & Afriansyah, 2020) stated that creative thinking could initiate unusual, well-thought-out, task-appropriate ideas. It is followed by self-development from new ideas.

For students, creative thinking skills are necessary to solve problem and improve their learning outcomes (Wahyuni & Kurniawan, 2018). (Windiarti & Mayasari, 2019) It is one of the abilities that assists students to solve mathematical problems, both in the learning context and in everyday life. According to (Griffin & Care, 2015; Rozi & Afriansyah, 2022), presenting an overview of creativity as a thinking skill is one of the important aspects that must be developed in the thinking process. In line with (Utami et al., 2020), the study revealed that creative thinking contributed to the problem solving skill and learning outcome. Based on (Wahyuni & Kurniawan, 2018), they concluded that creative thinking skills were related to the student learning outcomes.

One way to develop creative thinking is to build self-confidence (Kiranadewi & Hardini, 2021; Murtiningsih, 2017). Self-confidence is one aspect of personalities that is formed due to the high level of confidence of being able to do something or act, optimistic, tolerant and responsible (Murtiningsih, 2017; Rochim, Hidayati, & Masruroh, 2023). Another aspect of personalities that is strongly believed to influence the development of creative thinking skills is students' scientific attitude.

The study of (Hunaepi, 2017) proved that scientific attitude is an essential part in the learning process. The result of the study (Kusuma et al., 2013) showed a positive correlation which revealed that the higher the scientific attitude, the better the students' outcome. In line with (Pratiwi et al., 2019), the study implied

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that scientific attitude positively and significantly influenced the students' understanding of physics concepts. The scientific attitude illustrates how students should behave in the learning process, respond to problems, conduct and interpret tasks, and develop themselves.

(Facione, 2020) argued that Scientific attitudes encompass curiosity, compassion, vigilance, trust, confidence, open-mindedness, flexibility, tolerance, fair-mindedness, honesty, vigilance, willingness to change opinions to think. (Sari, 2020) revealed that scientific attitudes have 6 main elements, namely curiosity, speculation, willingness to be objective, open-minded, willingness to postpone decisions until all the necessary evidence is available, willingness to assume that all scientific conclusions are provisional. Therefore, students are encouraged to posses excellent scientific attitude is possessed by individual students for smooth thinking to achieve learning goals and obtain a strong commitment to be successful and excellent learners (Harso et al., 2014). Among the natures of scientific attitudes provided by the previous studies, current study indicated the scientific attitude with curiosity, responsibility, critical thinking, open-mindedness, and teamworking.

Based on the literature review and theoretical assumptions regarding scientific attitudes and creative thinking skills of students, it is necessary to study the scientific attitudes and creative thinking skills of students and prove whether there is a relationship between the two variables.

II. METHOD

This study used equal-status mixed methods, namely using a qualitative descriptive approach and a quantitative approach (Hands, 2022). The descriptive qualitative approach was used to answer the first and second questions, namely to describe the scientific thinking profile of students and the level of creative thinking skills of students. Meanwhile, the quantitative approach was utilized to answer the third question, namely examining the relationship between scientific attitudes and students' creative thinking skills. Equal-status mixed methods were adopted because the researchers carried out the qualitative descriptive research and the quantitative research simultaneously.

The data collection techniques used were indirect communication and measurement techniques. The instruments were utilized to measure the students' scientific attitudes and creative thinking skills based on the respective indicators. The scale was a non-test categorical scale by adapting the summated Likert scale. According to Djaali and Muljono, Likert scale was appropriate to measure attitude, opinion, and perception of an individual or a group regarding education phenomena or issues (Zubaidah R et al., 2021). The instruments

were later content validated to measure the appropriateness and reliability of the panelist. After validating process, the trial process was conducted followed by item analysis and revision based on the results of validators.

The study was conducted in FKIP Unversitas Tanjungpura, Mathematics Education Study Program from August 2022 to November 2022. The population was all students who attended the assessment process of mathematics learning during semester 3. Meanwhile, the research sample was students who did not retake the assessment process in the 2022/2023 academic year. Cluster random sampling technique were used to select the participants.

III. RESULT AND DISCUSSION

A. Descriptive Data of the Students' Scientific Attitudes

The data on the students' scientific attitudes are presented based on the indicators provided in the following table.

Table 1.
The data of the students' scientific attitudes based on the indicators

Dimension	Indicator	Responds (%)				
		SA	A	U	D	SD
Curiosity	Enthusiasm to ask and answer	28.2	38.1	18.3	12.4	6.6
	Desire to seek new information	28.4	40.6	16.2	8.2	7.4
	Try new things	29.7	42.9	15	10	9.2
	Total	86.3	121.6	49.5	30.6	23.2
	Average	28.8	40.5	16.5	10.2	7.73
Responsibility	Commitment to the settled decision	30,5	45.8	23.4	12.6	7.7
	Finish the task completely	19.9	47.9	12.3	12.2	0
	Take the risk	22.8	45.7	20.2	11.3	2.4
Total		73,2	141.4	55.9	36.1	10.1
Average		24.4	47.8	18,6	12	3.37
Critical thinking	Question a friend's discovery	23.5	40.6	23.1	10.4	2.8
	Draw a conclusion	22.4	47.3	13.5	13.5	1.9
	Repeat the activity	26.7	44.6	17	10.8	5.7
Total		72,6	132.5	53,6	34,7	13.7
Average		25.68	44.95	17.4	11.6	3.43
Open-mindedness and teamwork	Appreciate others' opinion	31.2	44.8	10.7	7.6	6.6
	Not enforcing own's opinion	28.9	45.8	12.3	13.4	7.1
	Courage to express opinions	28	46.9	9.8	8.7	6.6
	Accept criticism and advice	26.7	45.5	9.9	10.4	7.5
	Active in the team	27.5	46.2	11.6	9,5	5,2
Total		142,3	229.2	49,6	51.6	33
Average		28,46	45.82	9,92	10,32	6,6

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Based on the Table 1 the summary of the students' scientific attitudes are:

Table 2.
The summary of the average of the students' scientific attitudes

Dimension of scientific attitudes	Skills				
	Strongly agree (SA)	Agree (A)	Uncertain (U)	Disagree (D)	Strongly disagreed (SD)
Curiosity	28,8%	40,5%	16,2%	10,2%	7,75 %
Responsibility	24,4%	47,8%	18,16 %	12%	3,37 %
Critical thinking	21,68 %	44,95 %	17,4%	11,6%	3,43 %
Open-mindedness and teamwork	28,46 %	45,82 %	9,92%	10,32 %	6,6%
Total	107,34%	179,07%	62,42 %	44,12 %	22,12 %
Average	26,835%	44.77 %	15,61 %	11,03 %	5,53 %
	70,605%		15,61% 16,56 %		

Table 2 shows that the average students who agreed and strongly agreed for all dimensions of scientific attitudes were 70.605%, uncertain 15.61% and disagreed and strongly disagreed 16.56%.

B. The descriptive data of the students' creative thinking skills

Data on the percentage of creative thinking based on indicators is presented in the following table:

Table 3.
Summary Percentage of Creative Thinking Ability

Creative thinking aspects	Ability			
	Very high	High	Moderate	Poor
Fluency	32,43 %	45,54 %	13,92%	8,11%
Flexibility	26,32 %	42,05 %	18,22%	14,41%
Originality	30,03 %	43,24 %	19,62%	8,11%
Elaboration	29,73 %	48,54 %	12,92%	8,8%
Total	118.51%	179.37%	75.68%	32.43%
Average	29.63 %	44.83 %	18.92%	6,61%

Table 3 shows that the score of students' creative thinking skills is classified as very high 29.63%, high 44.83%, moderate 18.92% and poor 6.61%.

C. The Hypothesis Test Results

The hypothesis stating "There is a relationship between scientific attitudes and creative thinking skills of students in the course of assessment and evaluation of mathematics learning" was tested through Kendall Tau as the data was ordinal scale.

Table 4.
The hypothesis test results

Correlations

			Scientific attitudes	Creative thinking
Kendall's tau_b	Scientific attitudes	Correlation Coefficient	1.000	.493**
		Sig. (2-tailed)	.	.000
		N	37	37

	Creative thinking	Correlation Coefficient	.493**	1.000
		Sig. (2-tailed)	.000	.
		N	37	37

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4 shows the results of the analysis to see the relationship between scientific attitudes and creative thinking using Kendall's Tau test. The result was sig. 0,000 and the correlation coefficient 0,493. The profile of scientific attitudes of students was assessed based on four dimensions, namely curiosity, responsibility, critical thinking and open-mindedness and teamwork.

D. Discussion

The scientific attitudes profile of students was assessed based on four dimensions, namely curiosity, responsibility, critical thinking and open-mindedness and teamwork. The curiosity attitude dimension consisted of indicators of the enthusiasm to ask questions and seek answers, the desire to look for new information and be creative and try new things. Average scientific attitudes regarding curiosity dimension comprised 77.76 strongly agree and agree. 17.93% of the participants disagreed and strongly disagreed. Responsibility dimension consisted of the commitment to the settled decision, finish the task completely, and take risks. 60.3% of the students strongly agreed and agreed. Critical thinking dimension consisted of questioning a friend's discovery, drawing conclusions, repeating the activities showing 75.53% of strongly agree and agree and 15.03% of disagree and strongly disagree. Open-mindedness and teamwork dimensions encompassed not enforcing own's opinions, courage to share opinion, accepting criticism and advice and being active in the team. The average of open-mindedness and teamwork showed 74.28% agree and strongly agree. 16,9% of the participants disagreed and strongly disagreed.

Referring to these findings, it can be concluded that scientific attitudes in the aspect of curiosity, responsibility, critical thinking, open-mindedness and teamwork were categorised as high. Overall, 75.56% of the students agreed and strongly agreed. Meanwhile, 17.56% of the students disagreed and strongly disagreed. These findings showed that the students' scientific attitudes of all dimensions were high. It is believed that the scientific attitudes of students had been well formed through the learning process that emphasized a lot of practice, discussion and intensive research from various sources related to the development of authentic assessment instruments.

The flexibility aspect of representing very high and high categories was 68.37%. The percentage of indicator achievement was classified as moderate. In line with Silvia, et al (2015), it was stated that the flexibility aspect in problem solving was

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40.91%, categorised as moderate. Critical thinking skills in the aspect of originality were categorised as high and very high at 73.27%. Moderate and poor skills formed 27.73% of the students. Elaboration aspect of critical thinking skills were categorised as high and very high at 78.27%. Moderate and poor categories formed 21.77% of the students.

Based on the description, it showed that creative thinking skills in very high and high categories were greater in percentage than moderate and poor categories. the study concluded that the students' creative thinking skills were categorised as high. According to (Leikin & Lev, 2013), students with sophisticated creative thinking skills had a tendency to perform better than others. A study by (Handayani, 2021) revealed that students who were categorised in the higher level were able to demonstrate the three indicators well. Creative thinking also affected learning outcomes, learning achievements, writing skills, spatial abilities (Jamilah, 2020; Kemala Sari et al., 2021; Wahyuni & Hidayati, 2020; Zifarma, 2022).

The results of data analysis using the Kendall Tau test using the SPSS program obtained sig = 0.00 and the Kendall Tau correlation coefficient was 0.493 **. The significant level α = 5% resulted sig < α. Thus, the research decision rejected Ho. The conclusion of the study was that there was a relationship between scientific attitudes and students' creative thinking skills. The value pf Kendall Tau coefficient was 0,493** illustrating that the relationship between scientific attitudes and creative thinking skills was categorized strong. This means that the scientific attitudes variable contributed to the development of students' creative thinking. In line with the (Yuliatin et al., 2021), it was concluded that there was a positive and significant relationship between scientific attitudes and creative thinking skills among college students. Meanwhile, the study by (Wahyuni & Kurniawan, 2018) demonstrated that there was a relationship between creative thinking skills and student learning outcomes. According to the previous studies, scientific attitudes also affected science knowledge competence, learning achievement, cognitive ability, chemical creative thinking, and learning outcomes. (Adi et al., 2019; Nursa'adah & Rosa, 2016; Razak & Kamaruddin, 2018; Sarwanto, 2021; M. Wahyudi & Wulandari, 2021; W. Wahyudi, 2016; Widiastuti et al., 2018).

IV. CONCLUSION

The students' profile of scientific attitudes was divided into four dimensions, namely: a) curiosity, categorized as high, b) responsibility, categorized as high, c) creative thinking skills, d) open-mindedness and teamwork, categorized as high.

Creative thinking ability is measured through creative thinking indicators, namely aspects of fluency, flexibility,

originality, and elaboration. The aspects of fluency, originality and elaboration were categorized as high. On the other hand, the flexibility aspect was included in the moderate category. The result of hypothesis testing showed that there was a significant relationship between scientific attitudes and students' creative thinking skills in the assessment and evaluation process of mathematics course subject.

Further research is needed regarding the use of innovative learning models that can improve creative thinking skills, critical thinking skills and improve students' scientific attitudes. Further research on a wider sample needs to examine the relationship of several variables to find out which variables contribute more to the development of student abilities both in cognitive aspects, attitudes and other psychological aspects.

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