Proceeding of ICMR 6(2), 230-237 DOI: https://doi.org/10.32672/picmr.v621.1232

Computational Thinking Ability in Learning in Terms of Learning Style and Gender

Netti Kariani Mendrofa[1*], Edi Syahputra[2], Elmanani Simamora[3]

[1]Universitas Nias, Sumatera Utara, Indonesia
[2,3]Universitas Negeri Medan, Sumatera Utara, Indonesia

*Corresponding author: netti.mend14@gmail.com

Abstract. *This study aims to analyze students' computational thinking ability based on learning style and gender in basic mathematics courses. The research sample was students of the mathematics education study program, FKIP, Nias University in the first semester of the 2023/2024 academic year. This research is quantitative descriptive research. This type of data analysis technique uses quantitative data analysis. The instruments used are learning style questionnaire and computational thinking ability test. The results showed that learning style and gender have a significant influence on the average score of students' computational ability.*

Keywords: *computational thinking, learning style, gender*

1. Introduction

The rapid sophistication of technology in the era of industry 4.0 and society 5.0, all sectors have an exclusive role, especially education, to create reliable human resources (Satriawan et al., 2023); (Q et al., 2017); (Bawamenewi, 2022). The world of education plays an active role in designing and developing learning curricula that shape students to have skills and be able to compete at national and international levels as agent of change (Dintarini et al., 2022); (Fatahillah & Faradillah, 2023). The complex challenges faced in the 21st century mean that students should not only be equipped with basic knowledge but need to have the ability to develop the skills needed in the 21st century (Hamdi et al., 2023).

Education is very important for the progress of a nation because the quality of education determines the quality of its human resources. Various parties are increasingly paying attention to education nowadays (Setiana & Purwoko, 2020). To help students adapt to the 21st century, schools must provide education that fosters students' abilities to think critically, creatively, communicate and work together. The rapid development Information and Communication Technologies (ICT) has encouraged education to apply computational thinking (CT) in schools around the world (Hoffmann & Fern, 2019); (Qirom & Dahlan, 2023). Mastery of ICT is very necessary to equip students to have the ability to create new values through creative, innovative, collaborative, communicative and open-minded thinking (Rahaju et al., 2023).

The research on computational thinking ability in learning holds significant importance due to its potential to enhance problem-solving, critical thinking, and creativity across various disciplines Gong et al. (2020). This integration has been recognized as valuable, with efforts to explore and develop this phenomenon in more detail (Jasutė & Dagienė, 2014). Computational thinking has the potential to nurture essential skills for the 21st century, such as problem-solving, information processing, and system design (Reffay & Viroonluecha, 2019).

Computational thinking also has the potential to bridge various domains, such as mathematics, science, social science, languages, and arts, to discuss corresponding

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learning behavior objectives when integrating computational thinking ability (Lai, 2023). This interdisciplinary nature of computational thinking highlights its relevance in addressing complex, interconnected challenges in our rapidly changing global society (Miller et al., 2014). Moreover, it has a positive impact on students' learning motivation, self-efficacy, and awareness, as demonstrated in various educational contexts (Fang et al., 2022). Furthermore, research on computational thinking ability in learning extends to its potential to enhance pedagogical approaches and curriculum development. Studies have explored the effectiveness of cloud-based learning programs, game-based learning activities, and flipped-classroom instruction in developing computational thinking skills among students (Arood et al., 2020). Additionally, the integration of computational and creative thinking has been shown to improve students' learning and achievement in computer science classrooms (Shell et al., 2017).

Moreover, computational thinking has the potential to cultivate essential skills, such as reflective thinking, problem-solving, and self-regulated learning, in various subject areas, including trigonometry and Islamic education (Sholihah & Firdaus, 2023). The development of algorithmic and programmatic thinking at the primary school level further highlights the significance of integrating computational thinking into state educational programs (Katyetova, 2023). Additionally, the exploration of computational thinking based on students' experiences in game-based learning activities has led to the development of a taxonomy of computational thinking for enhancing 21st-century skills (Yatim, et al., 2021).

The gap in research related to computational thinking ability in learning is multifaceted and encompasses various dimensions that warrant further investigation. While existing studies have made significant contributions to understanding computational thinking, several areas remain underexplored. The influence of learning styles on computational thinking ability remains an area with significant research gaps. While some studies have examined the relationship between learning styles and critical thinking ability Rini et al. (2020), there is a need for more in-depth investigations into how different learning styles, such as visual, auditory, and kinesthetic, impact the development of computational thinking skills. Additionally, exploring the effectiveness of instructional models tailored to specific learning styles in enhancing computational thinking ability would provide valuable insights for educators.

Furthermore, the gender-based differences in computational thinking ability require more extensive research. While some studies have investigated the influence of gender on computational thinking skills (Aliman et al., 2019), there is a need for longitudinal studies that delve deeper into the developmental transformation of programming skills and the cognitive effects of learning computer programming based on gender (Pea & Kurland, 1984). Understanding how gender influences the acquisition and application of computational thinking skills can inform the development of more inclusive and effective educational interventions. Addressing these gaps through rigorous empirical studies and longitudinal research will contribute to a more comprehensive understanding of computational thinking and its implications for education.

Technological developments in education not only improve cognitive aspects but also affective and attitudinal components. Learning style is one aspect that must be considered in the learning process (Hoffmann & Fern, 2019). Learning styles are cognitive, affective and psychological behaviors that show how individuals interact with the learning environment (Wijayanti et al., 2023). Not all students have the same learning style, where each student has a learning style that is natural and comfortable for each of

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them (Barnewold & Lottermoser, 2020). Each student has a specific way of learning that enables him/her to quickly grasp the acquired knowledge and effectively solve mathematical problems during the course of learning (Qiao et al., 2022). Each person has a diverse learning style and is not necessarily the same as others (Qirom & Dahlan, 2023). Some students prefer when teachers teach by writing everything on the blackboard, so they can read it and understand it. But some other students prefer the teacher to deliver the material orally so that they can listen and understand. There are also students who prefer to form small groups and discuss the subject matter (Ulfah et al., 2023).

In addition, there are also students who prefer learning that uses props (Ebrahimzadeh et al., 2013). If the teacher is able to adjust to the different learning styles possessed by his students, students will have an interest in learning mathematics. Based on the problems that have been described, it is necessary to analyze how students' mathematical computational thinking skills when viewed from learning styles and gender (Dalle, 2023). One of the learning styles based on information processing is David Kolb's learning style, which argues that four tendencies affect a person's learning orientation. They are concrete experience (feeling), reflective observation (seeing), abstract conception (thinking), and active experimentation (doing). If these four tendencies are combined, four learning styles will be formed, namely diverger, assimilator, converger, and accommodator learning styles.

2. Method

This research is a descriptive study using a descriptive quantitative approach. The purpose of this study is to describe the learning conditions, especially how students master computational thinking skills based on their learning styles (Fatahillah & Faradillah, 2023). The research instrument starts with a learning style questionnaire to determine what learning style students use (Litia & Sinaga, 2023); (Romero et al., 2017). This research tries to see the effect of learning style and gender on students' computational thinking ability.

The subjects involved in this study were first semester students in the Basic Mathematics course. By choosing subjects on a small scale, it is expected to explore more in-depth information through interviews (Sezer, 2022); (Ulfah et al., 2023). Data collection tools used in this study include computational thinking ability test and learning style armature. Students' learning style data were collected before the exam through a validated learning style questionnaire instrument. The results of the instrument trial were analyzed using SPSS. The results of the analysis show that the instrument has met the reliable requirements with a Cronbach’s alpha value of 0,835. The instrument is reliable if the Cronbach alpha value = 0,7 or above (Taber, 2018).

3. Results and Discussions

The results showed that David Kolb's learning styles (diverger, assimilator, converger, and accommodator) affect how students learn about computational learning styles. The research was conducted on first semester students of the Class of 2023. Based on the data obtained from the research results, it can be seen that gender and learning style have an influence on students' computational thinking ability. When comparing the average score between male and female students, the female gender has the highest score, but it is the male students who have the highest score. The students' computational thinking ability test consists of 5 questions in the form of descriptions.

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The following is a description of the students' computational thinking test results based on learning style and gender.

Table 1. Summary of average student score based on learning style
CT * LEARNING_STYLE

LEARNIGN_STYLE	Mean	N	Std. Deviation	Minimum	Maximum	% of Total Sum
DIVERGER	74.7368	19	16.87155	25.00	95.00	56.2%
ASIMILATOR	57.2222	9	20.32718	30.00	90.00	20.4%
KONVERGER	27.5000	4	11.90238	20.00	45.00	4.4%
AKOMODATOR	53.3333	9	30.00000	20.00	95.00	19.0%
Total	61.5854	41	24.88571	20.00	95.00	100.0%

Table 2. Summary of average student score based on gender
CT * GENDER

GENDER	Mean	N	Std. Deviation	Minimum	Maximum	% of Total Sum
BOY	61.7647	17	25.85665	20.00	90.00	41.6%
GIRL	61.4583	24	24.73684	20.00	95.00	58.4%
Total	61.5854	41	24.88571	20.00	95.00	100.0%

Based on Table 1, it can be seen that the overall mean score of the CT test results given is 61.58 with a maximum score of 95 and a minimum score of 20. The grouping of students' learning styles shows that their learning style tendencies are accommodative and convergent. This indicates that first semester students as a whole prefer to solve problems and make decisions effectively and practically and prefer to cooperate with others to complete tasks, set goals, carry out fieldwork, and test various solutions to problems. Table 2 shows that the mean score for male students is higher than female students, at 61.76. When analyzing the problem solving process, it was found that the level of computational thinking ability of students based on gender reached the generalization stage. Male students solve the given problems with concepts that are practical and easy to understand, while female students in solving problems explain the flow and concepts in a structured manner. Based on the scores obtained from the CT proficiency test, statistical tests were then carried out to see the significant effect of learning style and gender on student scores with two-way anova. The following are the results of the analysis through SPSS.

Table 3. Descriptive statistics
Dependent Variable: CT

GENDER	LEARNING_STYLE	Mean	Std. Deviation	N
BOY	DIVERGER	81.4286	8.01784	7
	ASIMILATOR	64.1667	18.55173	6
	KONVERGER	22.5000	3.53553	2
	AKOMODATOR	25.0000	7.07107	2
	Total	61.7647	25.85665	17
GIRL	DIVERGER	70.8333	19.63685	12
	ASIMILATOR	43.3333	18.92969	3
	KONVERGER	32.5000	17.67767	2
	AKOMODATOR	61.4286	29.11390	7
	Total	61.4583	24.73684	24
Total	DIVERGER	74.7368	16.87155	19
	ASIMILATOR	57.2222	20.32718	9
	KONVERGER	27.5000	11.90238	4
	AKOMODATOR	53.3333	30.00000	9
	Total	61.5854	24.88571	41

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Based on the result in Table 3, it can be concluded that the general effect is seen if there is an influence of gender and learning style with computational thinking ability. From the table it can be seen that learning style has a significance value (sig.) <0.05, this indicates that learning style has an influence on computational thinking ability. From the table it can also be seen that gender has a significance value (sig.) <0.05, this indicates that gender also has an influence on students' computational thinking ability. Based on the interaction of gender and learning style has a significance value (sig.) <0.05 then this indicates that gender and learning style provide an influence on computational thinking skills.

Tabel 4. Tests of Between-Subjects Effects
Dependent Variable: CT

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Noncent. Parameter	Observed Power[b]
Corrected Model	12246.356[a]	7	1749.479	4.609	.001	32.264	.980
Intercept	67940.297	1	67940.297	178.996	.000	178.996	1.000
GENDER	94.975	1	94.975	3.250	.046	.250	.077
LEARNIGN_STYLE	10892.222	3	3630.741	9.566	.000	28.697	.994
GENDER * LEARNIGN_STYLE	3475.498	3	1158.499	3.052	.042	9.157	.662
Error	12525.595	33	379.563				
Total	180275.000	41					
Corrected Total	24771.951	40					

a. R Squared = .494 (Adjusted R Squared = .387)
b. Computed using alpha = .05

Based on the results of the data analysis of the computational thinking ability test, it can be seen that the average computational thinking score of male students is higher than the average score of female students. It is also seen from each grouping of each learning style that the average value of male students is higher than the average value of female students. According to Leder (2019), the National Assessment Program-Literacy and Numeracy (NAPLAN) indicates that females routinely outperform boys in reading, writing, spelling, and grammar, and that boys outperform girls in computations. The NAPLAN statement indicates that men are more adept at performing mathematical computations. Similarly, male students outperformed female students on the mathematics critical thinking ability test employed in this investigation.

Based on the process of solving math problems, female students are more structured and better than male students. However, male students in solving problems prefer practical steps. Therefore, what needs to be considered in learning in a class that has a variety of learning styles is to inform the subject about the learning style that tends to be owned so that the subject can maximize the right way to learn. For teachers, they can combine teaching styles so that they support all learning styles that students have.

4. Conclusions

The conclusion of this study is that the computational thinking ability of male students is higher than that of female students. Furthermore, learning style and gender have a significant influence on the average value of students' critical thinking ability. mathematical students.

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5. Acknowledgments

Thank you to my supervisor. I would also like to thank all those who helped in completing this research.

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