JPPIPA 9(12) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Metacognition and Thinking Style: Unlocking the Potential of Physics Problem Solving

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Received: October 12, 2023
Revised: November 17, 2023
Accepted: December 20, 2023
Published: December 31, 2023

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DOI: 10.29303/jppipa.v9i12.6151

Abstract: Thinking styles and metacognition are related as they both have the same space in assessing one's own abilities. Metacognition and thinking styles have an important role in unlocking the potential of physics problem solving. The objective of this study is to investigate the relationship between metacognition, thinking styles (particularly those proposed by Gregorc), and physics problem solving. The study involved a cohort of 364 students who were pursuing a physics degree at Tadulako University. The results indicated that metacognition behavior exhibited in the process of solving physics problems was classified as high category. The most dominant thinking style was abstract sequential, while the least was concrete random. The data analysis showed a significant difference in metacognition behavior between groups categorized by thinking style. Specifically, the concrete sequential (SK) group exhibited a significant difference with the abstract random (AA) group. These results provide further understanding of how metacognition and thinking styles play a role in physics problem solving. This study contributes significantly to comprehending the connection between metacognition, thinking styles, and the successful resolution of physics problems. The insights gained provide prospects for formulating more efficient physics learning methods that will ameliorate students' aptitude in tackling physics problems.

Keywords: metacognition; physics problem solving; thinking style

Introduction

Metacognition is a term used for a type of higher-order thinking that involves self-evaluation, monitoring, and control of one's cognitive processes (Schraw & Dennison, 1994). Metacognition refers to an individual's ability to understand and control their own learning, information processing, and problem-solving abilities (Flavell, 1979). Previously, examinations of metacognition have distinguished two main components: knowledge about cognition and regulation of cognition (Sengul & Katranci, 2012; Stephanou & Mpiontini, 2017). Knowledge of cognition means the depth of understanding one possesses about oneself, the optimal learning techniques to employ, and the most suitable contexts in which to utilize these techniques. Meanwhile, regulation of cognition means the extent to which an individual effectively engages in activities such as planning, employing learning strategies, monitoring progress, and evaluating learning outcomes (Schraw & Dennison, 1994; Sperling et al., 2004).

The research findings consistently demonstrate the significant role of metacognition in various aspects of learning, accomplishment, and other related traits For example, several studies (Colthorpe et al., 2018; Ghanizadeh, 2017; Jahangard et al., 2016; Srinivasan & Pushpam, 2016) show that students with better metacognitive awareness tend to achieve higher academic performance and become the biggest factor for success in problem solving (Balta et al., 2016).

The importance of metacognition in physics problem-solving is crucial for enhancing physics

How to Cite:
Haeruddin, Werdhina, I. K., Jarnawi, M., Syamsuriwal, Prasetyo, Z. K., & Supahar. (2023). Metacognition and Thinking Style: Unlocking the Potential of Physics Problem Solving. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 11429–11440. https://doi.org/10.29303/jppipa.v9i12.6151

learning outcomes (Chi, 2006; Yuberti et al., 2019). Several studies show evidence that students who are able to regulate their cognition tend to succeed in problem-based learning (Hmelo-Silver, 2004; Uyar et al., 2018), and can improve their academic achievement., as well as improve their academic performance (Winston et al., 2010).

Several researchers have investigated the metacognition process involved physics problem solving among students, including (Abdullah, 2006; Haeruddin, Prasetyo, Supahar, et al., 2020; Taasoobshirazi et al., 2015; Taasoobshirazi & Farley, 2013). However, one aspect that requires further research is the relationship between metacognition and thinking styles. Thinking styles refer to an individual's preferences in using his or her intellectual abilities (Sternberg & Zhang, 2005; L. F. Zhang & Sternberg, 2005).Thinking style reflects the way an individual chooses to apply his/her intellectual abilities and knowledge in dealing with a problem (Grigorenko & Sternberg, 1996).

Studying the relationship between thinking styles and metacognition has both theoretical and empirical significance. Theoretically, there is a conceptual link between thinking styles and metacognition. Previous research has shown that ability (or self-assessment of ability) is closely related to thinking style (Sternberg, 2001) as well as metacognition (Schraw & Dennison, 1994). A professional's cognitive and metacognitive skills influence their thinking style (Saini et al., 2022). Therefore, thinking styles and metacognition can be closely related as they both have a same domain in evaluating one's cognitive abilities.

Metacognition and thinking styles play an important role in unlocking the potential of physics problem-solving. Metacognition referes to the understanding the thinking and cognitive processes involved in problem solving (Sengul & Katranci, 2012). Developing metacognition enables individuals to comprehend the strengths and weaknesses in the physics problem-solving process (Gok, 2010; Pugalee et al., 2012). This can help identify areas where learners encounter difficulties and develop a better understanding of effective approaches in solving physics problems (Abdullah, 2006; Balta et al., 2016; Mansyur et al., 2018; Rahayu & Hertanti, 2020). Understanding learners' thinking styles can be used to develop problem-solving strategies that match their tendencies and preferences (Lin et al., 2013; I. P. M. Sari et al., 2023). Each individual has a unique way of thinking (L. Zhang et al., 2013). By recognizing students' thinking styles, teachers can adjust the approach used in the learning process and solve physics problems. This facilitates the efficiency and effectiveness in the processes of problem-solving and learning.

Gregorc's thinking style categorized individuals based on their preferences in organizing space and time (Gaden, 1992). Thinking styles include concrete and abstract, as well as linear and random. The combination of individual thinking styles can create differences in approaches to information, ranging from the five senses to intuition and imagination. This idea exemplifies the multitude of methods by which people process knowledge (Joniak & Isaksen, 1988; O'brien, 1990).

Physics problem solving requires a strong understanding of physics concepts as well as effective cognitive strategies (Aisy et al., 2020). Students who possess metacognition skills and adopt appropriate thinking styles are better equipped to deal with complex physics problems, make connections between different concepts, and develop more efficient problem-solving strategies (Fitriyanto et al., 2018). Consequently, investigating the relationship between metacognition, thinking styles, and physics problem solving has the potential to improve students' abilities in problem solving and promote a deeper understanding of physics concepts.

This research is of crucial importance because metacognition, which encompasses the evaluation, monitoring, and control of cognitive processes and individual thinking styles, plays a significant role in physics problem solving. According to research evidence, students with heightened metacognitive awareness tend to achieve higher academic performance and success in problem solving.

Metacognition in physics problem solving not only influences learning outcomes but also facilitates the identification of students' problem areas. The relationship between metacognition and thinking styles is a significant area of research, as they are closely intertwined in assessing individual abilities. By comprehending this correlation, we can create more efficacious strategies for physics education that cater to students' preferences.

Gregorc's thinking styles, which encompass concrete-abstract and linear-random perspectives, play a crucial role in information processing. Teachers can enhance efficiency and efficacy in solving physics problems by identifying learners' thinking styles and customizing learning approaches accordingly.

This study seeks to investigate the link between metacognition, thinking styles, and physics problem-solving among physics education students. The study's findings will offer an extensive comprehension of the metacognitive processes and thinking styles that enhance successful physics problem-solving. This will enrich scientific literature while providing the potential for creating more effective learning strategies and interventions in physics education.

Method

This research was a descriptive study using a quantitative approach. This study aims to describe the condition or behavior of metacognition in solving physics problems based on thinking styles in physics students at Tadulako University Palu. The type of ex-post facto research was chosen with the aim of describing the condition of the ongoing variables as in their original state without giving any action (Lodico et al., 2010). This research was conducted to investigate several sources of information in order to characterize metacognitive activity in student problem-solving. This research was carried out in two stages. The first stages involved administering instruments to measure metacognitive behavior in solving physics problems and thinking style. The second phase involved giving tests to solve physics problems, followed by interviews.

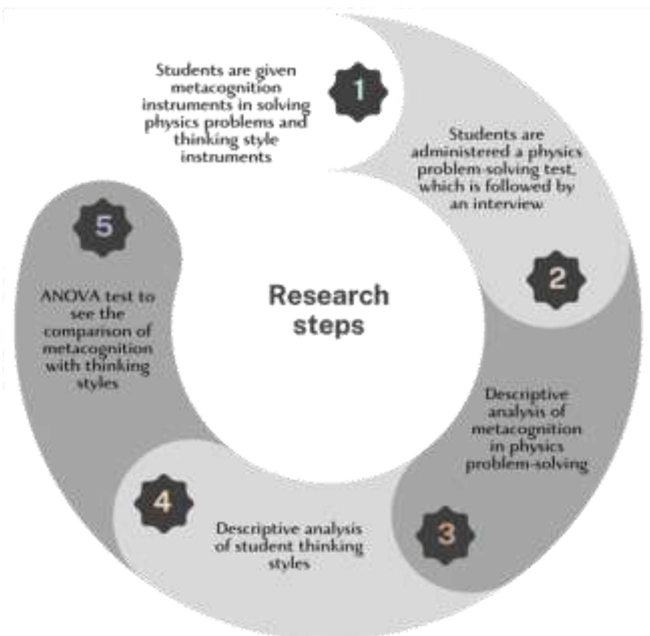

Figure 1. Flow diagram of research implementation.

This study involved a group of students enrolled in the physics department at Tadulako University. We emphasized voluntary participation to ensure that students gave honest answers. In total, there were 364 students who participated in this study. Questionnaires were administered to 364 students, with 63% (N = 228) female, and 37% (N = 136) male enrolled in the Physics Education and Pure Physics Study Programs at Tadulako University. Data were collected through instrument sheets given directly to respondents.

The instruments used to collect data consist of two, specifically metacognition instruments in solving physics problems and thinking styles. The metacognition instrument in solving physics problems had been tested with a reliability of .90 (Haeruddin, Prasetyo, Supahar, et al., 2020) and the thinking style instrument had a reliability of .90 (Haeruddin et al., 2023).

The thinking style instrument employs a statement rather than a question as a stimulus, enabling individuals to express their potential actions in a particular situation. A forced-choice method was used, wherein individuals were prompted to prioritize and score four situations that most accurately depict their characteristics. Statements were arranged situationally from four personal characteristics of thinking style types, then statement items from each construct were paired with other constructs. The result obtained was a map of the strength of a person's thinking character.

Descriptive statistical analysis was used in this study is through the calculation of the ideal mean, and ideal standard deviation. The calculation of the ideal mean and standard deviation was calculated with reference to the norm, namely the ideal mean (Mi) = (½ (ideal highest score + ideal lowest score)) and the ideal standard deviation (Sdi) = (1/6 ((ideal highest score - ideal lowest score)). The ideal highest score and ideal lowest score were obtained based on the assessment range (score range 1 - 4). The highest score was 4 multiplied by the number of statement items, as well as the lowest score was 1. The results of the calculation of Mi and Sdi were categorized as the tendency of metacognitive behavior variables in solving physics problems (Azwar, 2014).

The data analysis of metacognition behavior in solving physics problems and thinking styles was conducted descriptively, namely by calculating the percentage of students who have a certain thinking style. The metacognition behavior of physics students at Tadulako University was analyzed using the SPSS ANOVA test to determine their thinking style. This test was used to determine whether there is a difference in the average value of metacognition of each thinking style group. If there was a difference in the average value of metacognition of each group which one was higher.

An anova test was used to examine the comparison of metacognition behavior among four groups of thinking styles namely abstract random (AA), concrete random (AK), abstract sequential (SA) and concrete sequential (SK). Anova test compares the variation of scores of each different group. A ratio F-test was used to analyze the variation within groups.

The criteria used by looking at the sig. value of each thinking style group that is smaller than .05. In addition, by looking at the average difference in the mean difference column which has an asterisk (*). The next calculation was to see the sample effect used by calculating the eta squared value using equation (1).

$$Eta\ Squared = \frac{Sum\ of\ squres\ between - group}{Total\ sum\ of\ square} \quad (1)$$

The results of ANOVA analysis were used to explore the differences in thinking styles towards metacognitive behavior in solving physics problems. The respondents explored were divided into four groups (AA: Random Abstract, AK: Random Concrete, SA: Abstract Sequential and SK: Concrete Sequential).

Result and Discussion

In this section, we will present noteworthy research on metacognition, thinking styles, and their interrelation. Firstly, we will explicate research findings on metacognition description, which illustrates how individuals handle and regulate their understanding of received information. Subsequently, we delve into the domain of thinking styles, which involves examining a plethora of cognitive preferences that can impact one's problem-solving, decision-making, and cognitive skills.

Description of Metacognition

Based on the range of scores and the number of items, the ideal highest score = 160, the ideal lowest score = 40, the ideal average (Mi) = 100 and the ideal standard deviation (Sdi) = 20. Using equation 15, the score range for each category was calculated, as shown in Table 1.Results should be clear and concise. The discussion should explore the significance of the results of the work, not repeat them. A combined Results and Discussion section is often appropriate. Avoid extensive citations and discussion of published literature.

Table 1. Categories of Metacognition Behavior in Solving Physics Problems

Score Range	Category	Total	%
$X > 130$	Very High	47	12.91
$110 < X \leq 130$	High	155	42.58
$90 < X \leq 110$	Medium	159	43.68
$70 < X \leq 90$	Low	3	0.82
$X \leq 70$	Very Low	0	0

Based on Table 1, it is known that 42.58% are in the high category, and 43.68% in the medium category. When considering an average score of 114 and including it in the criterion table (Table 1), the metacognition behavior in solving physics problems is in the high group.

During the process of problem solving, students engage in active thinking activity to solve problems, which can lead to the creation of new information (Haeruddin, Prasetyo, & Supahar, 2020). As constructivist theory claims, this process requires self-organization of experience, and requires learners to organize their own cognitive structures, forming new knowledge based on existing knowledge, and awareness of the current knowledge structure (Salmon, 2008; Schunk, 2008).

Using existing knowledge provides an appreciation an understanding of the importance of accommodating unfamiliar knowledge. The knowledge of a specific strategy acquired in a particular problem setting might be applied to develop a different strategy in a comparable, yet unfamiliar context (Chekwa et al., 2015). Therefore, constructivism not only emphasizes the constructive process, but also emphasizes to be aware and control the construction process. Thus, according to a cognitive constructive viewpoint, self-regulation and self-awareness can be understood as the result of metacognitive processes.

Employing metacognitive skills allows students to plan, monitor, and evaluate their performance while solving the problems (Malawau, 2023; T. N. I. Sari, 2023). Students with metacognitive skills can more easily identify the nature of a problem, select effective strategies, manage their time, apply relevant knowledge, assess their progress, and analyze their evaluations to improve their performance (Pretz et al., 2003). Therefore, metacognitive behavior involves self-reflection, which enables an individual to strategically utilize their knowledge for efficient problem-solving (Pantiwati et al., 2023). Cooperative learning can be utilized as a tool to foster metacognitive development (Putria et al., 2020), while Schoology applications can be utilized to support metacognition skills (Nurdiyanti & Wajdi, 2023).

Description of Thinking Style

The thinking style questionnaire is used to describe the cognitive approach that students possess, employing a numerical scale ranging from 1 to 4. The responders typically spend approximately 10-20 minutes completing this quiz. Participants completed the questionnaire by prioritizing the four items according to the conditions that most accurately represent themselves. The statements are organized by pairing four personal characteristics of thinking styles.

Table 2. Respondents' Thinking Style Profile

Types of Thinking Styles	Male	Female	Total	%
AA	23	37	60	16.48
AK	24	18	42	11.54
SA	38	72	110	30.22
SK	33	70	103	28.30
AA and AK	1	4	5	1.37
AA and SA	2	5	7	1.92
AA and SK	1	4	5	1.37
AK and SA	1	2	3	0.82
AK and SK	1	3	4	1.10
SA and SK	9	10	19	5.22
AA, AK and SK	1	1	2	0.55
AA, SA and SK	2	2	4	1.10
Total	136	228	364	

Table 2 shows that the most dominant thinking style among physics students is abstract sequential (30.22%) and the lowest is concrete random (11.56%). Overall, 43 students (11.81%) have two types of thinking styles, and 6 (1.65%) students have three types of thinking styles.

The prevalence of thinking styles with multiple types is typically lower. This demonstrates that each individual has a tendency to have one type of thinking style. There are 5 students who have the tendency of thinking style types AA and SK, as many as 7 students who have the tendency of thinking style AA and SA, and 5 students with the type of thinking style AA and SK. Students with this type of thinking style tend to manage information abstractly.

How to process information randomly, seen in students who have a tendency to AK and SA thinking styles (3 people) AK and SK (4 people). A total of 19 students who have a tendency to SA and SK thinking styles, this type tends to process information sequentially. There are two students who have three thinking style tendencies AA, AK and SK, this type tends to receive information randomly and manage it concretely. In addition, there are 5 students who possess the thinking style of AA and SK. Individuals exhibiting this cognitive style typically handle information sequentially and manage it randomly.

Different thinking styles lead to different problem-solving processes in each person, so the results may also be different (Güner & Erbay, 2021). A person's thinking style is a combination of how he absorbs, and then organizes and processes information. Information obtained from understanding is then organized and managed in the brain (DePorter & Hernacki, 2016; Evendi, 2022).

Factors that influence the way of thinking include how a person sees the problem situation, experience and intelligence . Thinking style is not an ability, but a pleasure in using the ability that is owned. An ability relates to how well a person can do something. Thinking style relates to how a person likes to use their abilities to do things (Cano-García & Hughes, 2000; Zhang et al., 2013). Based on the pleasure of using their abilities, it is necessary to consider the thinking style of students when implementing learning. The results of the study revealed that the learning outcomes of students who were given certain learning models and media also differed based on their thinking styles (Depary & Mukhtar, 2013; Menap et al., 2021; Yulianci et al., 2021)

Other studies have reported the relationship between thinking styles and academic achievement (Bernardo et al., 2002; Cano-García & Hughes, 2000; L. F. Zhang, 2000) as well as the interaction between thinking style and type of academic assessment (Sternberg & Grigorenko, 1993) between learner and teacher thinking styles (Sternberg & Grigorenko, 1995) and between thinking style and academic subject (Zhang, 2000) which has implications for students' academic performance. Several studies have called on educators to revise teaching and assessment strategies to accommodate students of different thinking styles (Sternberg & Grigorenko, 1993, 1995).

The various approaches individuals employ reveal their unique cognitive styles and determine the most effective methods for absorbing, organizing and managing the information they receive (Bancong & Subaer, 2015; DePorter & Hernacki, 2016; Setyawan & Rahman, 2013). Teachers must be able to see the abilities and skills of students, because the level of understanding and knowledge of a person depends on how they receive and process the information provided. Teachers must possess an understanding of their thinking style and the manner in which they construct knowledge.

Metacognitive Behavior Based on Thinking Style

ANOVA test is used to see the comparison of metacognitive behavior of four thinking style groups, namely abstract random (AA) concrete random (AK), abstract sequential (SA) and concrete sequential (SK). ANOVA test compares the variation of scores of each different group. Table 3 shows that the highest average metacognitive behavior score is SK and the lowest is AA.

Table 3. Descriptive Analysis of Metacognition Behavior of Each Thinking Style

Kel.	*N*	*Mean*	*Std. Deviation*	*Std. Error*	*95% Conf. Interval for Mean*		*Min.*	*Max.*
					Lower Bound	*Upper Bound*		
AA	60	110.77	11.526	1.488	107.79	113.74	84	137
AK	42	112.74	14.132	2.181	108.33	117.14	92	144
SA	110	113.63	12.844	1.225	111.20	116.05	85	152
SK	103	117.73	14.546	1.433	114.89	120.57	77	152
Total	315	114.30	13.556	0.764	112.80	115.81	77	152

The significance value (sig.) of Test of Homogeneity of Variances is greater than 0.05 (0.331) so that it fulfills the assumption of homogeneity variation. Based on the ANOVA table, the significance value (sig.) which is smaller or equal to 0.05 indicates a statistically significant difference between each group. Based on the sig. value in the ANOVA table of 0.009 which is smaller than 0.05, it can be said that the metacognitive behavior of each thinking style group has a significant difference. To identify the difference, it is essential to carefully examine the multiple comparisons table of the post-hoc analysis results.

Table 4. Average Difference of Metacognition Behavior of Each Thinking Style Group

(I) TypeGB		Mean Difference (I-J)	Std. Error	Sig.
AA	AK	-1.97	2.69	1.00
	SA	-2.861	2.15	1.00
	SK	-6.96*	2.17	0.01
AK	AA	1.97	2.69	1.00
	SA	-0.89	2.43	1.00
	SK	-4.99	2.45	0.25
SA	AA	2.86	2.15	1.00
	AK	0.89	2.43	1.00
	SK	-4.10	1.83	0.16
SK	AA	6.96*	2.17	0.01
	AK	4.99	2.45	0.25
	SA	4.10	1.83	0.16

The criteria used by looking at the sig. value of each thinking style group that is smaller than 0.05. Furthermore, by looking at the average difference in the mean difference column which has an asterisk (*). Based on Table 4, it can be seen that the SK group has a difference with the AA, AK and SA groups. However, the thinking style group that exhibits a significant difference is AA compared to SK. The value shows the comparison between the two thinking style groups is significantly different at the $p < 0.05$ level. This means that there are differences in metacognitive behavior between students who have AA thinking style and student groups who have SK thinking style.

The next calculation is to see the sample effect used by calculating the eta squared value using equation 1. Using the SPSS output value in the ANOVA table, namely Sum of Squares Between Groups = 2111.784 and total Sum of Squares = 57700.743, the eta squared is 0.037. Referring to Cohen's value which states that the value of eta squared 0.01 as a small effect, 0.06 medium effect and 0.14 large effect. In the illustration with an eta value of 0.021, it means that the sample size effect is medium.

Research evidence shows that students who possess metacognitive abilities exhibit better academic achievement (Eriyani, 2020; Goren & Kaya, 2023; Özçakmak et al., 2021) and demonstrate greater motivation towards learning (Sinatra & Pintrich, 2003). This study examines the relationship between intellectual style and metacognition. Intellectual style is a term that includes cognitive style, learning style and thinking style, referring to the way people prefer to use the abilities they have (Devy et al., 2022; Fan, 2016; Rais & Aryani, 2017). Ability refers to how well one can do something, while intellectual style refers to one's reference for performing a task. Nonetheless, each intellectual style carries its own meaning.

This research shows that self-assessment ability is related to intellectual style and metacognition (Andrade, 2019; Hayat et al., 2020; Johnson, 2017). Intellectual style and metacognition are related to each other because they are in the same space, namely self-assessment ability. However, apart from being in the same space, intellectual style and metacognition also have another similarity which is supported by information processing. Therefore, intellectual style, which encompasses thinking style and metacognition, remain related to each other.

Regarding the data concerning the relationship between thinking styles and metacognition, there is a significant difference at the $p < 0.05$ level in the metacognitive behavior scores of the four thinking style groups. Thinking style groups have differences in the average value of metacognition behavior in solving physics problems (Asy'ari & Da Rosa, 2022). The AA group is significantly different from the SK group, while the AK and SA groups are not significantly different from the other two groups (AA and SK). The average value of each group obtained a picture of respondents who have the highest average value of metacognition behavior in solving physics problems is SK and the lowest is AA. The question is: What should be seen from the significant statistical test results? Do these results likely to be relevant data or statistical findings?

First, there is no similarity in the phrasing of each statement in the two instruments. Items in metacognitive behavior describe individuals' awareness (Altıok et al., 2019) and regulation of their learning processes, whereas thinking style items emphasize people's preferences for using their abilities (Agarwal & Rani, 2015). Therefore, the statistically significant relationship found between thinking styles and metacognitive behaviors is due more to the underlying conceptual relationship rather than similarities in the terminology used in the items on both instruments (Mokhtari & Reichard, 2002; Pugalee et al., 2012).

Second, certain thinking styles statistically contribute to metacognition, as indicated in Table 5. Concrete sequential thinking style provides the highest correlation to metacognitive behavior in solving physics problems. This condition can be explained because of the similarities shared with metacognitive behavior, specifically adhering to reality and information that is processed in an orderly manner (Asy'ari et al., 2022). Concrete sequential type uses more senses such as using pictures in the problem-solving process. Concrete sequential thinking style pays attention and recalls facts, information, formulas, and specific rules easily. As an illustration, individuals who have metacognitive organization tend to reflect on the physics problem being worked on and then re-evaluate (Halim et al., 2021).

The third predictor is abstract sequential thinking style. Efficiently managing cognitive processes requires implementing novel approaches beyond just awareness of the current situation. Abstract sequential types like to think about concepts, analyze information, and find it easy to research important things, such as keywords and details (Devy et al., 2022). This is consistent with metacognitive behavior because to be aware of what and how to do physics problem solving (i.e., knowledge of cognition), one must have a strong tendency to analyze information. In other words, if you want to successfully solve physics problems, you must make improvements, evaluate and actively think about checking yourself at that time (Fitroh et al., 2020).

Table 5 demonstrates that the abstract random and concrete random thinking style types contributed significantly less. Abstract random types tend to experience events holistically by seeing events as a whole, rather than in stages. Concrete random types have an experimental attitude accompanied by less structured behavior and often use a trial-and-error approach. This state does not align with metacognitive behavior that requires structured steps in solving physics problems.

Table 5. Correlation between Thinking Style and Metacognition Behavior

Thinking Style	Metacognition Knowledge	Metacognitive Regulation
Random Abstract (AA)	0.01	0.02
Randomized Concrete (AK)	0.10	0.16**
Abstract Sequential (SA)	0.14**	0.17**
Concrete Sequential (SK)	0.22**	0.27**

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
c. Listwise N=364

The discussion did not imply a causal relationship between the two instruments. The conclusion is based on the high metacognition skills of individuals, because they more often use a concrete sequential thinking style. This finding is in line with the results obtained in research by Borkowski et al., (1969), Palladino et al., (1997), Zhang (2010) which examined the relationship between thinking styles and metacognitive processes. As with previous research, which concluded that learners have different levels of metacognition based on the type of thinking style.

Conclusion

The study found that the majority of students demonstrated a high or moderate level of metacognitive behavior, indicating proficiency in planning, monitoring, and evaluating their approach to solving physics problems. The dominant thinking style displayed was abstract sequential, while concrete sequential, concrete random, and abstract random followed. These findings suggest that thinking styles, particularly concrete sequential, significantly impact students' metacognition. Structured and detail-focused thinking styles reveal a substantial and favorable relationship with metacognitive capability. Such discoveries offer valuable insights into contemplating thinking styles while developing physics teaching and evaluation approaches, as they hold the capacity to enhance the problem-solving proficiency of students. To conclude, metacognition and thinking styles assume a fundamental function in comprehending how students surmount physics-related problem-solving hardships.

Acknowledgments
The author would like to thank the Rector and Dean of FKIP Tadulako University for allocating funds to carry out this research.

Author Contributions
Conceptualization, H. and I.K.W.; methodology, H. and Z.K.P.; validation, I.K.W., Z.K.P. and Su.; formal analysis, H., M.J. and Sy.; investigation, M.J. and Sy.; resources, H., I.K.W., Z.K.P. and Su; data curation, H., M.J., and Sy; writing—original draft preparation, H., and I.K.W; writing—review and editing, H., M.J. and Sy.; visualization, Sy. and M. J. All authors have read and agreed to the published version of the manuscript.

Funding
The research was funded by DIPA FKIP Tadulako University with contract number 6805/UN28/KU/2023 for the fiscal year 2023.

Conflicts of Interest
The authors declare no conflicts of interest. The funders did not participate in the study's design, data collection, analysis, interpretation, manuscript writing, or decision to publish the results.

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