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Understanding Physics: The Influence of Cognitive Styles and Student Interest

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Abstract

This research investigates the influence of cognitive styles and learning interest on students' understanding of physics concepts. Using a survey method with a sample of 88 first-year students from four programs at a Health Polytechnic in South Jakarta, data were collected through questionnaires on cognitive style perception, learning interest, and a physics concept understanding test. Findings from multiple regression analysis reveal: (1) Cognitive styles and learning interest collectively have a significant influence on physics concept understanding ($p = 0.000$, $F = 26.084$); (2) Cognitive style perception independently affects concept understanding ($p = 0.047$, $t = 2.013$); and (3) Learning interest significantly impacts concept understanding ($p = 0.001$, $t = 3.426$). The study highlights the interplay between cognitive preferences and motivation in achieving mastery of physics concepts.

Keywords: cognitive style, learning interest, physics education

INTRODUCTION

Physics forms the cornerstone of scientific understanding and technological development, particularly in healthcare. For Health Polytechnic students, mastery of physics concepts is critical for interpreting and utilizing advanced medical tools, such as CT scans and MRI machines. However, the abstract and mathematical nature of physics presents unique challenges to students (Redish & Kuo, 2015). Two key factors—cognitive styles and learning interest—have been identified as crucial in shaping students' ability to grasp complex concepts. Cognitive styles pertain to the individual ways students process and organize information, while learning interest serves as a motivational factor that encourages engagement and persistence. Understanding how these variables influence physics learning is essential for improving educational strategies in the field.The Health Polytechnic, as a vocational higher education institution in the field of health, aims to produce professional, reliable, and competent healthcare workers. The learning process at the Health Polytechnic is designed integratively, involving theoretical learning in classrooms as well as practical sessions in laboratories and fieldwork at various hospitals and health industries.One of the subjects taught is Physics. This course integrates physics concepts with health sciences. Through this learning process, students are expected to gain a deep understanding of physics concepts and be able to implement them in daily activities, particularly in the health sector. The Physics course is known as a natural science that studies various phenomena in the universe. Physics is fundamental and serves as the foundation for the development and advancement of other scientific disciplines (Burhanuddin, 2018; Zahara et al., 2024). This field supports numerous pure and applied research efforts, including those in the health sector. Many laboratory and hospital equipment operate based on the application of physics concepts, such as medical imaging technologies (CT scans, MRI), diagnostic tools, and therapeutic devices. Therefore, students of Health Polytechnic must thoroughly understand physics concepts to utilize these technologies effectively and optimally. This not only enhances their technical competencies but also deepens their understanding of ongoing innovations in the healthcare field.

Physics is known as a natural science that studies natural phenomena. It is fundamental in nature and serves as the foundation for the development and advancement of other scientific disciplines (Susanto, 2021). Physics significantly supports both pure and applied research, including in the field of health. Many laboratory and hospital devices utilize physics concepts in their operation (Handayani, 2023). Therefore, students in Health Polytechnic institutions must be able to understand physics concepts to effectively utilize and apply physics knowledge, especially in the healthcare sector. The study of physics aims to provide a comprehensive understanding of the subject. This holistic perspective can be achieved through the process of analyzing fundamental principles, discussing their limitations, and outlining their implications. Physics is often perceived as a collection of separate sciences, interconnected yet lacking a truly unified perspective (Saifuddin, 2015). As a quantitative science, physics relies on mathematics to express its ideas and concepts clearly.

Understanding can be expressed verbally, non-verbally, or in the form of a framework of thought. It serves as the foundation for developing insights, as understanding involves the mental process of transforming and adapting knowledge (Puspitasari & Febrinita, 2020).

Understanding holds a strategic and crucial position in the learning process (Amri & Kurniawan, 2023). Students who memorize a theory do not necessarily comprehend it. On the other hand, if students truly understand a theory, they will automatically remember it. Therefore, in the process of learning physics, students need to develop a proper and accurate understanding of physics concepts to achieve the learning objectives. Lecturers must be aware of the indicators that signify students have attained a good understanding of physics concepts. Understanding physics concepts refers to Anderson's taxonomy, a revised version of Bloom's taxonomy. This taxonomy includes seven cognitive processes that constitute the ability to understand. These cognitive processes are interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining (Misu et al., 2019).

Several dimensions of individual differences can influence the learning process. According to Birgili, (2015), besides differences in levels of intelligence, creative thinking ability, and problem-solving skills, individuals may also differ in how they process knowledge and establish connections between one experience and another.

Cognitive style refers to the characteristic way in which an individual forms attitudes and beliefs about their surroundings (Kozhevnikov et al., 2014; Sternberg & Zhang, 2014). It is the method or approach by which a person processes the information they receive and reacts to it. Each individual has distinct characteristics, which means that the way they think, evaluate, and behave will vary too (Bargh, 2014; Krosnick & Petty, 2014).

The learning experience of an individual can be observed through their perception, as perception is a process related to the reception of stimuli and information in the human brain. Information is received through the senses and then processed by the brain to form a conclusion about something (De Ridder et al., 2014).

Information about students' perceptions of their cognitive styles will help lecturers understand their thinking patterns in comprehending specific concepts, including physics concepts. Lecturers must know whether students have accurately understood the physics concepts being taught, as one of the goals of education is to provide students with the means to understand knowledge (Fitria, 2014; Hasibuan et al., 2024). This includes understanding physics concepts

The lack of understanding of physics concepts among students is caused by insufficient knowledge of the physics material (Jonassen & Carr, 2020). This lack of knowledge is related to the students' lack of interest in studying the physics course. Interest is the desire and effort of an individual to learn and seek something. Interest has a strong driving force to bring about an activity. It becomes a powerful source of motivation and plays a significant role in encouraging individuals to learn. Similarly, students may lack the motivation to study the physics course because the material they are learning does not align with their interests. This leads to a lack of understanding of physics concepts among students.

RESEARCH METHOD

Research Design

This study employs a survey method with a multiple regression analysis model to explore the relationships between cognitive styles, learning interest, and understanding of physics concepts.

Population and Sampling

The study involved 739 first-year students across four academic programs at the Health Polytechnic in South Jakarta. A random sampling technique was employed, resulting in a sample of 88 students.

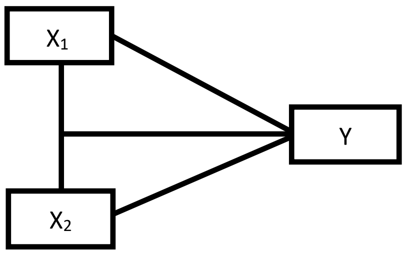
Instruments

1. Cognitive Style Perception Questionnaire: Comprising 32 Likert-scale items.
2. Learning Interest Questionnaire: Containing 28 Likert-scale items.
3. Physics Concept Understanding Test: A multiple-choice test with 35 questions covering kinematics.

Data Analysis

Data were analyzed using SPSS to perform descriptive statistics, normality tests, linearity tests, and multiple regression analyses

This study uses a survey research method, and the research design employs multiple linear regression. This design can be seen in Figure 1.



X_1 = Perception of cognitive style
X_2 = Learning interest
Y = Understanding of physics concepts.

Figure 1. the research design

The population size in this study is 739 individuals. The researcher uses a margin of error of 10% for the sample size calculation. The sample consists of 88 first-year students in their first semester. The data collection technique employed is random sampling. In this study, the sample is randomly selected by drawing lots to determine how many individuals will be included in the sample.

This study uses two research instruments: a questionnaire and a test. The questionnaire consists of a cognitive style perception questionnaire with 32 statements and a learning interest questionnaire with 28 statements. The questionnaire uses a five-point Likert scale for responses. The test instrument is used to assess the understanding of physics concepts, consisting of 35 multiple-choice questions on the topic of kinematics of motion.The instrument trial is conducted to determine its validity, reliability, discriminative power, and difficulty level.

This study uses descriptive data analysis techniques. The characteristics of the respondents' scores for each variable are described. Next, data assumption testing is performed using classical assumption tests, including normality, linearity, multicollinearity, and heteroscedasticity tests. Multiple linear regression, F-test, and t-test are used to test the research hypotheses.

RESULTS AND DISCUSSION

A summary of the descriptive data as a whole, with the help of testing and calculations using the SPSS 20 application, is presented in Table 1.

Tabel 1. A summary of the descriptive

No	Descriptive Measure	Cognitive Style Perception	Learning Interest	Physics Concept Understanding
1	Mean	121.81	107.76	75.44
2	Median	122.5	109	75.5
3	Modus	109	107	74
4	Standard Deviation	11.688	11.976	8.474
5	Minimum	91	76	60
6	Maximum	145	128	94

According to Table 1, the understanding of physics concepts has a mean of 75.44, a median of 75.5, a mode of 74, a minimum value of 60, and a maximum value of 94, which indicates a fairly good level of understanding. For cognitive style perception, the highest score is 145, the lowest score is 91, the mode is 109, the median is 122.5, the mean is 121.81, and the standard deviation is 11.688. For learning interest, the highest score obtained is 128, the lowest score is 76, the mode is 107, the median is 109, the mean is 107.76, and the standard deviation is 11.976.

Table 2. Normality Test

No	Data	Sig	Conclusion
1	perception of cognitive style	0.200	Normal Distribution
2	Learning Interest	0.200	Normal Distribution
3	Physics Concept Understanding	0.69	Normal Distribution

Based on Table 2, the three data sets in the study follow a normal distribution. The p-values (sig) greater than 0.05 for each research variable prove this distribution.

Table 3. Linearity Test

No	The Relationship Between Variables	Sig	Conclusion
1	Cognitive Style Perception and Physics Concept Understanding	0.237	linear relationship
2	Learning Interest Physics Concept Understanding	0.209	linear relationship

Based on Table 3, the variable "perception of cognitive style" and the variable "learning interest" in relation to students' understanding of physics concepts have a linear relationship. This linear relationship is demonstrated by the significance value (sig) > 0.05. For the multicollinearity test, the results show a Variance Inflation Factor (VIF) = 2.035 (< 10) or tolerance = 0.491 (> 0.1). These values indicate that multicollinearity between the variables "perception of cognitive style" and "learning interest" does not occur in the regression analysis.

Table 4. However, if the table summarizes the multiple correlation coefficient test results analyzing the influence of perception of cognitive style and learning interest on understanding of physics concepts

R	R Square	Adjusted R Square	Stdr. Error of the Estimate
.617	.308	.366	6.749

Table 5. contains the summary of regression coefficient significance tests analyzing the influence of perception of cognitive style and learning interest on understanding of physics concepts

ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig
1 Regresi	2376.168	2	1188.084	26.084	0.000
Residual	3871.548	85	45.548		
Count	6247.716	87			

Table 6. summarizes the regression equation test results analyzing the influence of perception of cognitive style and learning interest on understanding of physics concepts

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig
	B	Stdr Error	Beta		
constanta	21.961	7.745		2.835	0.006
perception of cognitive style	0.178	0.088	0.245	2.013	0.047
learning interest	0.295	0.086	0.417	3.426	0.001

Based on Table 4, the correlation coefficient is 0.617. This coefficient was obtained through correlation analysis calculations. Using the SPSS application, the calculation confirmed the significance of the correlation coefficient. This indicates that perception of cognitive style and learning interest collectively influence the understanding of physics concepts. The coefficient of determination, 38%, signifies that the combined contribution of perception of cognitive style and learning interest to the understanding of physics concepts is 38%. The remaining 62% is attributed to other factors.

Based on the significance test of regression coefficients in Table 5, the results show that the regression coefficients are significant, as indicated by the FFF-value (Fcalculated=26.084) and a significance level (p=0.000<0.05p = 0.000 < 0.05p=0.000<0.05).

This means that perception of cognitive style and learning interest collectively have a significant influence on the understanding of physics concepts.

Based on Table 6, the regression equation is $\hat{\mathbf{Y}}$ = 21,961 + 0,178 X_1 + 0,295 X_2. The constant is 21.961, and the regression coefficients are as 0,178 and 0,295. This demonstrates a positive influence between perception of cognitive style and learning interest collectively on the understanding of physics concepts. Specifically, as both the perception of cognitive style and learning interest increase, the understanding of physics concepts also increases. The positive regression coefficients (0.178 for cognitive style and 0.295 for learning interest) indicate that both factors contribute positively to improving students' understanding of physics concepts.

Cognitive style refers to the mental structures formed through an individual's efforts to process information, as each person has different ways of processing information. The perception of cognitive style in students can be observed by paying attention to how they receive, respond to, and process the information they encounter. The information that students receive and process can influence their knowledge and understanding of physics concepts. How students interpret and engage with information plays a key role in shaping their comprehension of the subject matter.

Student learning interest plays a significant role in the learning process. This is particularly evident in courses like physics, where it influences the understanding of physics concepts. Learning interest encourages and motivates students to either enjoy or not enjoy certain subjects, including physics. When a student has a high learning interest in a physics course, they are more likely to enjoy the subject and be motivated to continue studying and understanding it. A student's interest in learning physics will directly affect their understanding of the physics concepts they are studying. Therefore, both perception of cognitive style and learning interest together influence the student's understanding of physics concepts.

Based on Table 6, the results show t count=2.013 and $p=0.047<0.05p = 0.047 < 0.05p=0.047<0.05$, leading to the rejection of H0H_0H0. This indicates that there is a significant effect of perception of cognitive style on the understanding of physics concepts.

Cognitive style refers to how an individual uses their cognitive functions (such as memory, thinking, processing information, organizing, and making decisions) over an extended period, and it is consistent in nature. The perception of cognitive style in students influences how they understand their environment or situation to acquire information, interpret and organize it, and apply it in action. This means that the way students perceive their cognitive style can significantly affect their ability to process and understand physics concepts.

Understanding physics concepts requires a learning process that absorbs more information or knowledge about physics concepts and how to apply them. Therefore, in order for students to have a better understanding of physics concepts, it is essential to understand their perception of the cognitive style they possess. Knowledge of students' perception of cognitive style can help both instructors and students understand physics concepts better by processing, analyzing, and organizing information. The conclusion of the study by Wiguna et al. (2014) aligns with the findings of this study. Their research suggested that cognitive style contributes to students' understanding of science concepts.

Based on the hypothesis test presented in Table 6, the results show t count =3.426 and $p=0.001<0.05p = 0.001 < 0.05p=0.001<0.05$. This result leads to the rejection of H_0, indicating that there is a significant effect of learning interest on the understanding of physics concepts.

Each individual has different attitudes when facing something, and these differences are caused by various factors within the person. These factors include differences in knowledge, interest, talent, emotional intensity, experience, and environmental conditions. Suharyat (2009) in his research explains that interest plays a crucial role in a person's life.

Interest has a strong influence on the attitudes and actions of each individual. It can serve as a driving force for someone to study and become a powerful source of motivation for learning.

The lack of understanding of physics concepts among students is significantly influenced by the extent of their knowledge of the subject matter. This lack of understanding is also caused by students' lack of interest in learning physics. This makes it difficult for students to understand physics concepts properly. However, students with a high interest in learning physics will increase their knowledge of physics concepts, which will positively affect their understanding of these concepts. This study presents findings consistent with the research by Rais and Ferinaldi (2019), which states that learning interest contributes to the understanding of concepts.

CONCLUSION

Based on the results of the research conducted, it can be concluded that there is a significant influence of cognitive style perception and learning interest on the understanding of physics concepts among students at the Health Polytechnic in South Jakarta. The analysis reveals that both factors, when considered together, play a crucial role in enhancing students' conceptual understanding of physics. This is supported by the statistical findings, which show a significance value of $p = 0.000 < 0.05$ and an F-calculated value of 26.084, indicating a strong relationship between the variables.

Furthermore, the research highlights the individual influence of cognitive style perception on students' understanding of physics concepts. The significance value of $p = 0.047 < 0.05$ and t-calculated value of 2.013 demonstrate that how students perceive and apply their cognitive styles directly affects their ability to grasp and internalize physics concepts. This suggests that differences in cognitive processing approaches among students can lead to varying levels of comprehension and retention in physics learning. Additionally, the study confirms that learning interest significantly impacts the understanding of physics concepts. The significance value of $p = 0.001 < 0.05$ and t-calculated value of 3.426 provide evidence that higher levels of interest in learning are associated with better conceptual understanding. This finding underscores the importance of fostering and maintaining student engagement and motivation in physics education.

Overall, the research emphasizes the critical role of cognitive style perception and learning interest in shaping students' academic performance in physics. It suggests that educators should consider these factors when designing instructional strategies to enhance the learning experience and improve student outcomes in physics courses.

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