ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 12| Issue: 5| May 2026|| Journal DOI: 10.36713/epra2013 ||SJIF Impact Factor 2026: 8.753 || ISI Value: 1.188

INFLUENCE OF METACOGNITIVE THINKING SKILLS AND ATTITUDES TOWARDS PHYSICS ON ATTENTION CONTROL AMONG STEM STUDENTS

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Article DOI: https://doi.org/10.36713/epra27737
DOI No: 10.36713/epra27737

ABSTRACT

Poor attention control in physics remains a challenge. This study examined metacognitive thinking skills and attitudes toward physics as determinants of attention control among 185 STEM students. Diagnostic design, stratified random sampling, survey technique, and multiple regression analysis were applied. The findings revealed that the student attention control was significantly influenced by the determinants. Hence, the Theory of Planned Behavior was partly affirmed. Future research may examine other factors related to the remaining 55% variance, while educators may strengthen attention control through programs that enhance metacognitive thinking skills and positive attitudes toward physics.

KEYWORDS: *Influence of metacognitive thinking skills, attitudes towards physics, attention control, STEM students*

INTRODUCTION

The Problem and its Scope

Globally, senior high school students experience challenges in maintaining attention control in physics, a subject that requires sustained focus and engagement with abstract concepts (Santos et al., 2025). Studies report that many learners exhibit difficulty concentrating during physics lessons, with frequent distractions and reduced focus observed in classroom settings (Uden et al., 2022). Furthermore, low levels of attention control in science-related tasks have been documented among students across various educational contexts (Rini et al., 2024).

In different countries, similar patterns have been noted. Students in Kazakhstan have shown decreased attention when dealing with complex physics concepts (Sagatbek et al., 2024), while learners in Nigeria and Indonesia have demonstrated limited attention alongside less favorable perceptions of physics and challenging learning conditions (Ukoh, 2025; Rini et al., 2024).

In the Philippines, attention control in physics remains a concern. Senior high school students in Davao City have been reported to experience difficulty sustaining attention during physics classes, with reduced participation and incomplete understanding observed (Salaña & Labastida, 2024). Other studies also indicate variations in students concentration and engagement in science learning (Santos et al., 2025).

Despite these findings, limited research has examined variables associated with attention control in physics among senior high school students. Existing studies primarily describe attention difficulties without analyzing how cognitive and affective factors, such as metacognitive thinking skills and attitudes toward physics, relate to it. Moreover, few Philippine studies simultaneously examine these variables in relation to attention control among STEM students. Hence, this study addresses this gap by examining the relationship of metacognitive thinking skills and attitudes toward physics with attention control.

Significance of the study

Aligned with Sustainable Development Goal 4 (Quality Education), this study highlights the importance of metacognitive thinking skills and attitudes toward physics as key predictors of attention control, contributing to improved learning outcomes and scientific literacy. Its findings provide valuable insights for policymakers, educators, and academic institutions in designing instructional strategies that enhance students focus, critical thinking, and self-regulated learning. On a broader scale, the study supports global efforts to strengthen science education, while at the student level, it emphasizes the development of positive attitudes and thinking skills essential for effective attention control and future STEM success. Furthermore, it offers a foundation for future research exploring the interaction of cognitive and affective factors in diverse educational contexts.

Statement of the Problem

This research aimed to explore the relationships between metacognitive thinking skills, attitudes towards physics, and attention control among senior high school STEM students through a series of focused objectives.

1. To determine the levels of metacognitive thinking skills in terms of thinking skills, reflective thinking skills towards problem-solving, decision-making skills and alternative skills of evaluation; the attitudes towards physics in terms of enthusiasm toward physics, physics learning, physics as a process, physics teacher, and

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physics as a future vocation; and the attention Control.
2. To determine the significance of the correlation between metacognitive thinking skills and attitudes towards physics, and attention control.
3. To determine the significance of the individual and combined influence of metacognitive thinking skills and attitudes towards physics on attention control.

Research Hypotheses

The following were tested at a 0.05 level of significance.

Ho1: There is no significant relationship between metacognitive thinking skills and attitudes towards Physics on attention control.

H**o**2: There is no significant individual and combined influence of metacognitive thinking skills and attitudes towards Physics on attention control.

Theoretical Framework

This study is anchored on the Theory of Planned Behavior (TPB) developed by Icek Ajzen (1991) fundamentally asserts that human behavior is primarily determined by behavioral intention, which is influenced by three key factors: attitudes, subjective norms, and perceived behavioral control. Attitudes refer to an individual's positive or negative evaluation of a behavior, subjective norms involve perceived social pressure from significant others, and perceived behavioral control refers to a person's perceived ability to regulate and perform the behavior. The theory explains that individuals are more likely to engage in a behavior when they hold favorable attitudes toward it, perceive support from others, and believe they have sufficient control over their actions.

In this study, metacognitive thinking skills represent perceived behavioral control, as these involve planning, monitoring, and evaluating one's cognition. These skills help students maintain better attention control during physics learning (Zetriuslita et al., 2024). Meanwhile, attitudes toward physics reflect the attitudinal component of TPB and are associated with improved classroom attention and engagement (Santos et al., 2025). Attention control serves as the behavioral outcome, referring to students' ability to sustain focus and manage distractions during learning tasks (Uden et al., 2022). The subjective norms have indirect role hence; the study was partly anchored to the theory.

Conceptual Framework

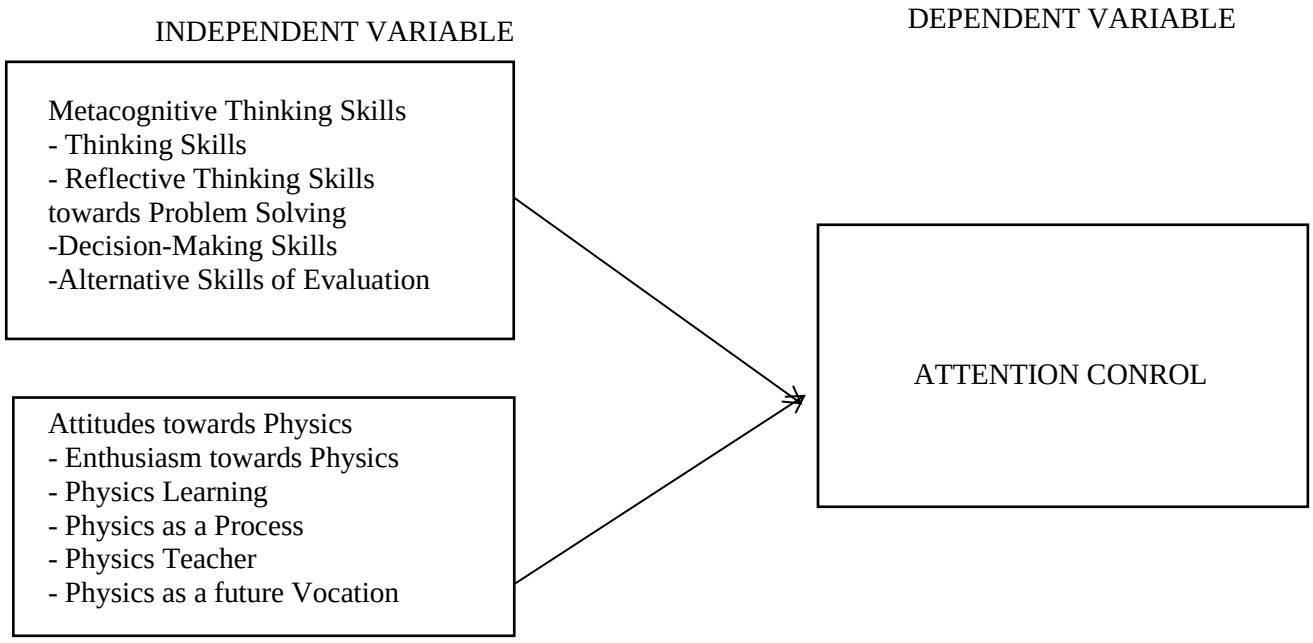


Figure 1. Conceptual Framework of the Study.

METHODOLOGY

The research design, locale of the study, the sample and sampling technique, data gathering technique, data analysis technique, and the ethical considerations are included in this chapter.

Research Design

This study employed diagnostic research design. This design is appropriate because it allows the researcher to describe the current levels of the variables and examine how they are related without manipulating the respondents natural setting (Best & Kahn, 2016). Moreover, it is a structured and problem-oriented research design used to examine present conditions, identify relevant patterns or relationships, and describe the strength of the determinant factor to influence the outcome (Wisenthige, 2023).

Locale of the Study

This study was conducted in private educational institutions in Davao City, Philippines, offering Senior High School (SHS) programs under the STEM strand. The selected institutions

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provided a suitable research setting due to their diverse student population, allowing for a focused examination of how metacognitive skills and attitudes toward physics influence attention control.

Sample and Sampling Technique

The respondents of this study included 185 Senior High School students enrolled in three private institutions for the school year 2025–2026 who provided informed consent (and parental consent where applicable). Students who were on extended leave or those who chose not to participate were excluded from the study. Senior High School STEM students were selected as participants because they are suitable for physics learning. At this stage, they exhibit more developed cognitive, academic, and inquiry-related skills, along with varying levels of interest toward physics learning.

Stratified random sampling was used to identify respondents from the total population of Senior High School STEM students. This method was selected to allow the inclusion of relevant subgroups within the population, supporting a more representative composition of respondents and contributing to the dependability of the findings. In addition, tools such as Raosoft, as cited by Lopez and Garcia (2021), were used to determine appropriate sample sizes based on the population size, supporting the rigor of the research design and reducing potential sampling error.

Data Gathering Technique

This study utilized an adapted survey technique to measure metacognitive thinking skills, attitudes toward physics, and attention control among senior high school STEM students. The research instruments were adapted from previously validated tools and modified to align with the local educational context, ensuring clarity, relevance, and suitability for the respondents. Prior to administration, all instruments underwent expert validation and reliability testing to establish their appropriateness and internal consistency. The use of adapted instruments allowed the researcher to apply established measures while aligning them with the characteristics of the target population, thereby supporting the validity and reliability of the data collected.

Three adapted survey questionnaires were used in this study. A 4-point Likert scale was employed to assess respondents' answers across the three instruments, ranging from 1 – strongly disagree to 4 – strongly agree, to reduce central tendency bias (Koo, 2025).

The Metacognitive Thinking Skills Questionnaire was adapted from Tuncer and Kaysi (2013). It consisted of four indicators: thinking skills, reflective thinking skills toward problem solving, decision-making skills, and alternative skills of evaluation. The instrument included 18 items with a Cronbach's alpha of 0.937, indicating high internal consistency. Attitudes Toward Physics Questionnaire was adapted from Kaur and Zhao (2017). It covered five indicators: enthusiasm toward physics, physics learning, physics as a process, physics teacher, and physics as a future vocation. The instrument consisted of 59 items with a Cronbach's alpha of 0.964, reflecting very high reliability. The third instrument, the Attention Control Scale was adapted from Derryberry and Reed (2002). It measured respondents ability to maintain and shift attention during learning tasks. The instrument consisted of 20 items with a Cronbach's alpha of 0.878, indicating acceptable reliability.

Data Analysis Technique

The researcher employed statistical tools to analyze the data, utilizing descriptive, correlation, and multiple linear regression analyses. Descriptive statistics, including weighted mean and standard deviation, is a statistical method used to summarize, organize, and describe the characteristics of a dataset using measures such as mean, frequency, percentage, and standard deviation, as well as tables and graphs. It is commonly applied in quantitative research to determine variable levels, identify patterns, and present data clearly before inferential analysis. Its advantages include simplifying complex data, improving interpretation and presentation of results, identifying trends, and providing a basis for further statistical analysis (Blbas, 2024; Wolniak, 2023).

The matrix below contains descriptive level and corresponding interpretations assigned to each variable involved in this study. The measures are used particularly in describing Metacognitive Thinking Skills, Attitudes Towards Physics, and Attention Control.

Range of Mean	Descriptive Level	Metacognitive Thinking Skills	Attitudes Towards Physics	Attention Control
3.26 - 4.00	Very High	Very Good	Very Good	Very Strong
2.50 – 3.25	High	Good	Good	Strong
1.75 - 2.49	Low	Poor	Poor	Weak
1.00 – 1.74	Very Low	Very Poor	Very Poor	Very Weak

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The following is the Standard Deviation Value Interpretation:

Range	Description	Interpretation
SD ≤ 0.50	Highly Consistent Responses	Strong and uniform perception
SD = 0.51 – 1.00	Moderately Consistent Responses	Acceptable consistency
SD = 1.01 – 1.50	Low Consistency Responses	Differing views or experiences
SD > 1.5	Very Low Consistency Responses	High variability and lack of consensus

The Pearson Product-Moment Correlation Coefficient was applied to assess the strength and direction of relationships among the variables and to test hypotheses on significant associations (Casinillo, 2023). Furthermore, multiple linear regression analysis was used to examine how well metacognitive thinking skills and attitudes toward physics predict attention control in learning, including necessary diagnostic checks such as multicollinearity (Setiawan & Surahmat, 2022).

Computed r	Descriptive Interpretation
+/- 1.00	Perfect Correlation
Between +/- 0.75 - +/- 0.99	High correlation
Between +/- 0.51 - +/- 0.74	Moderately high correlation
Between +/- 0.31 - +/- 0.50	Moderately low correlation
Between +/- 0.01 - +/- 0.30	Low Correlation
0.00	No Correlation

Multiple linear regression analysis was employed in this study to determine the influence of multiple independent variables on the dependent variable. This technique examined how well metacognitive thinking skills and attitudes towards physics predicted attention control in learning, with diagnostics such as multicollinearity also checked (Setiawan & Surahmat, 2022).

In this study, the significance of the correlation was tested at a 0.05 confidence level. The interpretation of the r-values followed the standard scale proposed by Guilford (1956), as outlined below:

Multiple Linear Regression analysis using unstandardized and standardized beta coefficients was further applied to assess the degree of influence and the overall predictive effects of Metacognitive Thinking Skills and Attitudes Towards Physics on Attention Control assuming a linear relationship among the variables (Hair et a., 2022).

In terms of Scale of Beta (β) Coeffecient Strength, the following scheme, as proposed by Cohen (1988) and Hair et al. (2019), was used:

β Value Range	Strength of Influence
± 0.00 - ± 0.09	Very Weak
± 0.10 - ± 0.29	Weak
± 0.30 - ± 0.49	Moderate
± 0.50 - ± 0.69	Strong
± 0.70 and above	Very Strong

Ethical Consideration

The study followed proper ethical standards to protect the respondents and ensure the accuracy and reliability of the results, while showing respect for the policies and authority of the Department of Education (DepEd) and school administrators. It complied with the guidelines of the Holy Cross of Davao College, Society for Moral Integrity and Legal Ethics (SMILE) and the Data Privacy Act of 2012. The researcher undertook ethical measures by securing written informed consent from respondents aged 18 and above, and parental consent with student assent for those under 18, with participation remaining voluntary and fully explained (Ederio et al., 2023). Privacy and confidentiality were maintained through password-protected digital files, secured physical records, and coded identities to preserve anonymity (Liu, 2023). Risks were minimal, participants could withdraw at any time without penalty, and equal opportunity for participation was ensured (Marín et al., 2022; Ederio et al., 2023). Transparency was also observed by clearly communicating the study objectives, procedures, and use of findings to participants and school administrators (Franzen et al., 2025).

RESULTS

Included in this chapter are the descriptive, correlation, regression, and mediation tabular presentation, and the corresponding analysis and interpretation of the statistical results. This chapter is ended with the summary of findings.

Descriptive Results

Shown in Table 1 are the descriptive statistical results of the study. The table presents the variables involved, namely,

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metacognitive thinking skills, attitudes toward physics, and attention control scale; along with the number of respondents, standard deviation, mean, and the corresponding descriptive levels for each variable.

Table 1. Descriptive Analysis Results (n=185)

Variables	***SD***	***Mean***	***Interpretation***
Metacognitive Thinking Skills	0.42	3.24	Very High
Thinking Skills	0.48	3.18	Very High
Reflective Thinking Skills Towards Problem Solving	0.48	3.20	Very High
Decision-Making Skills	0.46	3.32	Very High
Alternative Skills of Evaluation	0.47	3.25	High
Attitudes Towards Physics	0.39	3.20	High
Enthusiasm Towards Physics	0.49	3.13	High
Physics Learning	0.49	3.11	High
Physics as a Process	0.39	3.25	High
Physics Teacher	0.48	3.31	High
Physics as a Future Vocation	0.41	3.19	High
Attention Control Scale	0.41	3.11	Very High

Legend: 1.00-1.74 Very Low, 1.75-2.49 Low, 2.50-3.24 High, 3.25-4.00 Very High

Table 1 specifically shows that the metacognitive thinking skills variable had a mean of 3.24, described as very high. This indicates that the metacognitive thinking skills of the respondents were very high. Three of the indicators were described as very high, while one indicator was described as high. The standard deviation of 0.42 implies that the respondents generally demonstrate consistent self-regulation, monitoring, and evaluation of thinking processes. Furthermore, the attitudes toward physics variable had a mean of 3.20, described as high. This indicates that the attitudes toward physics of the respondents were positive. All indicators were described as high. The standard deviation of 0.39 signifies that the respondents generally exhibit consistent perceptions and attitudes toward physics learning and instruction. Additionally, the attention control variable had a mean of 3.11, described as very high. This indicates that the respondents demonstrate strong attention regulation during learning tasks. The standard deviation of 0.41 denotes that the responses were generally consistent across the variable.

The findings reveal that metacognitive thinking skills and attention control are at very high levels, while attitudes toward physics are at a high level, indicating that students demonstrate stronger cognitive regulation and attention control compared to their attitudes toward physics.

Correlation Results

Shown in Table 2 are the results of the correlation analysis between the independent variables and the dependent variable. It contains the r-value, p-value, decision on null hypothesis, and interpretation.

Table 2. Correlation Analysis Results

Variables	**Attention Control Scale**			
	r-value	**p-value**	**Decision on Ho 0.05 level of significance**	**Interpretation**
Metacognitive Thinking Skills	0.629	0.000	Reject Ho	Positive, Moderate and Significant Relationship
Attitudes Towards Physics	0.652	0.000	Reject Ho	Positive, Moderate and Significant Relationship

Table 2 specifically shows the correlation between metacognitive thinking skills, attitudes toward physics, and attention control variables, which both obtained a p-value of 0.000. Such a value is less than the 0.05 level of significance. Hence, the null hypothesis was rejected. It indicates that the correlations are statistically significant. The corresponding r-value of 0.629 indicates moderately high. This implies as metacognitive thinking skills increases, their attention control also tends to improve.

On the other hand, attitudes toward physics obtained a p-value of 0.000, which is less than the 0.05 level of significance. Hence, the null hypothesis was rejected. It indicates that the correlation is statistically significant. The corresponding r-value of 0.659 indicates moderately high. This implies as attitudes toward physics changes, their attention control also change.

The findings reveal that both metacognitive thinking skills and attitudes toward physics have significant relationships with attention control, with attitudes toward physics showing a stronger association compared to metacognitive thinking skills.

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Regression Results

Presented in Table 3 are the results of the regression analysis examining the influence of independent variables on dependent variable. It contains the unstandardized beta, beta coefficient, t-value, p-value, decision on null hypothesis, and the corresponding interpretation.

Table 3. Regression Analysis Results

Independent Variables	Attention Control Scale						
	Estimate	Std. Estimate	SE	t	p	Decision on Ho	Interpretation
Intercept	0.824		0.189	4.360	0.000		
Metacognitive Thinking Skills	0.274	0.280	0.096	2.840	0.005	Reject	Significant Influence
Attitudes Towards Physics	0.439	0.419	0.103	4.240	0.000	Reject	Significant Influence
$R= 0.671$, $R^2= 0.450$, Adjusted $R^2=0.444$, $F=74.4$, $Sig.=0.000$ *Level of Significance: 0.05* *Decision Rule: Reject H_o if $p<0.05$*							

Table 3 specifically shows that the influence of metacognitive thinking skills variable on attention control variable obtained a standardized Beta coefficient of 0.280. It indicates that the strength of the influence of metacognitive thinking skills on the dependent variable is weak. With the corresponding p-value obtained that is 0.005, which is less than 0.05 degree of confidence; thus, the null hypothesis was rejected. It denotes that the influence of metacognitive thinking skills on the dependent variable is statistically significant. This implies that for every unit change in metacognitive thinking skills, there is a corresponding 0.671 unit change in attention control in physics. Moreover, attitudes toward physics determinant obtained a standardized Beta coefficient of 0.419. It indicates that the strength of influence of attitudes towards physics on the independent variable is moderate. The corresponding p-value obtained is 0.000, which is less than 0.05 degree of confidence thus, the null hypothesis was rejected. It denotes that the influence of attitudes towards physics on the dependent variable is statically significant. This implies that for every unit change in attitudes towards physics, there is corresponding change in attention control.

The table also shows an R^2 value of 0.450. This indicates that the strength of the collective influence of the determinant variables on the criterion variable is moderate. The corresponding p-value of 0.000 is less than the 0.05 level of significance. Thus, the null hypothesis was rejected. This indicates that the combined influence of metacognitive thinking skills and attitudes toward physics on student attention control is statistically significant. This implies that for every unit change in the combined influence of the determinant variables, there is corresponding 0.450 unit change in the criterion variable.

The findings reveal that both metacognitive thinking skills and attitudes toward physics have significant relationships with attention control among STEM students. However, attitudes toward physics demonstrate a relatively stronger relationship with attention control compared to metacognitive thinking skills, while the combined determinants show a significant contribution to the criterion variable.

Summary of Findings

Based on statistical results, it specifically was found that:

1. Metacognitive thinking skills and attitudes toward physics are significantly correlated with attention control.
2. Metacognitive thinking skills and attitudes toward physics have individual and combined significant influence on attention control.

DISCUSSIONS

In this chapter, the descriptive, correlational, and regression analysis results of the study are discussed. The discussions are made to highlight how the results of the study support previous findings. Here, the conclusion and recommendations based on the results and discussions are also presented.

Correlation between Metacognitive Thinking Skills, Attitudes towards Physics, and Attention Control

The study found that both metacognitive thinking skills and attitudes toward physics are significantly correlated with attention control among STEM students. The finding affirms the study of Villanueva and Ramos (2022), reporting that metacognitive regulation is associated with improved focus and engagement. Similarly, the current finding supports the study of Rini et al. (2024) and Santos et al. (2025), explaining the positive attitudes toward physics are associated with better concentration. Likewise, Wong and Liem (2022), who also emphasized that student engagement and cognitive involvement contribute to improved attentional focus and learning outcomes in educational settings.

Conversely, this current finding contradicts Terneusen et al. (2024), who found that self-reported metacognitive monitoring did not align with actual attentional measures and, in some cases, showed negative relationships. The differing results may also be

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partly explained by sample size variation, with 128 participants in the earlier study compared to 185 respondents in the present study, providing stronger evidence for the observed relationships between metacognitive thinking skills, attitudes toward physics, and attention control.

Attention Control as influenced by Metacognitive Thinking Skills and Attitudes towards Physics

The finding of this study indicates that both metacognitive thinking skills and attitudes toward physics have a significant individual and combined influence on attention control among STEM students. This finding affirms the study of Ukoh (2025) and Sagatbek et al. (2024), reporting that positive attitudes are associated with higher student engagement and focus. Similarly, this current finding supports the study of Lee et al. (2022), explaining that the metacognitive awareness significantly predicts students' ability to regulate attention and sustain focus during learning tasks, further supporting the present study's findings.

Conversely, this current finding contradicts the study of Agrawal et al. (2025), explaining that the metacognitive awareness was not significantly related to attentional outcomes, suggesting that metacognitive skills may not consistently correspond to students' ability to regulate attention or sustain focus. The differing results may also be partly explained by sample size variation, with 100 respondents in the earlier study compared to 185 respondents in the present study, providing more robust evidence for the observed relationships between metacognitive thinking skills, attitudes toward physics, and attention control.

Conclusions

Based on the findings, it was concluded that individual and combined influence of metacognitive thinking skills and attitudes toward physics attention control among STEM students are significant. Hence, the Theory of Planned Behavior which fundamentally asserts that human behavior is primarily determined by behavioral intention, which is influenced by attitudes, subjective norms, and perceived behavioral control, was partly affirmed.

Recommendations

Based on the conclusion, further studies utilizing other variables not covered in the study are recommended to account for the remaining 55% of the variance in attention control. Qualitative research may also be conducted to generate emerging themes that could serve as potential variables of interest. Furthermore, school leaders and teachers may initiate programs and instructional strategies that enhance student metacognitive thinking skills and foster positive attitudes toward physics to strengthen student attention control.

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