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THE ROLE OF ATTENTION, MEMORY, AND METACOGNITION IN STUDENT LEARNING OUTCOMES

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Abstract

This study aimed to examine the role of attention, memory, and metacognition in predicting student learning outcomes in the Developmental Psychology course. Conducted in September 2025 in the Department of Islamic Religious Education, Faculty of Islamic Studies, Riau Islamic University, the research involved 101 third-semester students. Using a quantitative correlational design, data were collected through validated instruments, including the Attention Assessment Scale, the Working Memory Questionnaire, and the Metacognitive Awareness Inventory (MAI). Student learning outcomes were measured using final course grades. Descriptive statistics, Pearson correlations, and multiple regression analyses were used to assess the relationships among variables. The results showed that attention, memory, and metacognition were each positively and significantly correlated with student learning outcomes. Regression analysis further indicated that metacognition was the strongest predictor, followed by memory and attention, collectively accounting for a substantial proportion of the variance in academic performance. These findings highlight the importance of strengthening cognitive and metacognitive skills to enhance learning outcomes in higher education settings.

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Introduction

Cognitive processes such as attention, memory, and metacognition play crucial roles in shaping how students perceive, process, and retain academic information. Attention allows learners to focus on relevant stimuli, memory stores and retrieves information, and metacognition guides students in monitoring and regulating their learning strategies. In the context of higher education, concerns about declining sustained attention and increasing academic demands have intensified the need to understand how these three cognitive factors contribute to learning outcomes (Frazier et al., 2007; Haliti-Sylaj & Sadiku, 2024). Therefore, exploring the relationship between cognitive processes and student achievement is essential for informing effective instructional practices.

Attention has been widely linked to academic performance. Frazier et al. (2007) found that university students with attentional difficulties are more likely to experience reduced academic success, indicating that attention is a foundational component of effective information processing. Additional work by Haliti-Sylaj & Sadiku. (2024) demonstrated that frequent exposure to digital distractions reduces sustained attention and negatively affects comprehension and test performance. These findings suggest that attentional control is essential for maintaining engagement and maximizing learning outcomes in higher education environments.

Memory, particularly working memory, also plays a significant role in shaping academic achievement. Cole et al. (2024) reported that working memory capacity and organizational skills significantly predict academic outcomes across disciplines. Working memory limitations often hinder students' ability to engage in complex cognitive tasks, such as reading comprehension, reasoning, and integrating long-term knowledge. As a result, students with stronger memory skills are more likely to perform well academically due to their ability to process and retain new information efficiently.

Metacognition has similarly been identified as a strong predictor of academic achievement. Metacognitive processes enable learners to plan, monitor, and evaluate their learning strategies, helping them become more self-regulated learners. A meta-analysis by Bao et al. (2024) confirmed that students with higher metacognitive awareness tend to achieve better academic outcomes. Experimental research by Juhaňák et al. (2025) further demonstrated that metacognitive prompts can enhance learning by improving learners' monitoring accuracy and strategic regulation. These findings indicate that metacognition functions as both a cognitive enhancer and a compensatory mechanism when attention or memory resources are limited.

Although attention, memory, and metacognition have been extensively studied, most research examines these constructs independently rather than in combination. Murphy & Castel. (2023) highlighted that divided attention not only reduces memory encoding but also disrupts metacognitive monitoring, demonstrating the interconnectedness of cognitive functions. However, few studies have modeled the simultaneous contributions of attention, memory, and metacognition to actual university course outcomes. This gap suggests a need for more comprehensive

research that considers the interaction of these cognitive processes within authentic classroom settings.

In the Indonesian context, research on cognitive factors related to learning outcomes is growing but remains limited in scope. Much of the local literature focuses on metacognitive skills in online learning or school-based populations rather than university-level cognitive predictors. For example, Amien & Hidayatullah et al. (2023) found that metacognitive strategies improved student engagement and achievement in e-learning environments. However, studies examining combined cognitive predictors in face-to-face university courses are still lacking. This highlights the need for studies situated in Indonesian higher education contexts to generate more contextually relevant insights.

To address these gaps, the present study investigates the roles of attention, memory, and metacognition as predictors of student learning outcomes in a university-level Developmental Psychology course. Conducted in September 2025 at the Department of Islamic Religious Education, Faculty of Islamic Studies, Riau Islamic University, this study involved 101 third-semester students. It employed validated instruments to measure cognitive abilities and final course grades. By modeling the unique and combined contributions of attention, working memory, and metacognitive awareness, the study aims to provide evidence that can inform both theoretical understanding of cognitive interactions and practical strategies to enhance academic performance in Indonesian higher education.

Research Method

This study employed a quantitative correlational research design to examine the relationships between attention, memory, and metacognition on student learning outcomes, a design well-suited for identifying associations among naturally occurring cognitive variables without manipulating the learning environment (Creswell & Creswell, 2018; Fraenkel, Wallen & Hyun, 2021; Tran & Hasegawa, 2022). The participants consisted of 101 third-semester students enrolled in the Developmental Psychology course in the Department of Islamic Religious Education at Riau Islamic University, selected through purposive sampling based on criteria such as active enrollment, course completion, and willingness to participate—an approach commonly used in higher-education research to ensure sample relevance (Etikan, Musa & Alkassim, 2016; Zitha, Mokganya & Sinthumule, 2023; Ahmad & Wilkins, 2025). Data were collected using three validated instruments: the Attention Control Scale (Derryberry & Reed, 2002; Bürgler, Kleinke & Hennecke, 2022; Li et al., 2024), the Working Memory Questionnaire (Vallée-Tourangeau, Rendell & Phillips, 2011), and the Metacognitive Awareness Inventory (Schraw & Dennison, 1994), each demonstrating strong reliability in prior educational and cognitive research. Student learning outcomes were operationalized using official final course grades, which are widely recognized indicators of academic achievement (Pintrich, 2002).

Data collection was conducted in September 2025, following ethical approval. During this period, students completed printed versions of the Attention Control Scale (ACS), Working Memory Questionnaire (WMQ), and Metacognitive Awareness

Inventory (MAI) within a 30-minute session, after being briefed on the study procedures and confidentiality. Completed questionnaires were screened, coded to ensure anonymity, and securely matched with official grade records. Data analysis was conducted using SPSS, involving descriptive statistics for all variables, Pearson correlation to examine bivariate relationships, and multiple regression to determine the predictive contributions of attention, memory, and metacognition to student learning outcomes. Regression analysis is particularly appropriate for modeling how cognitive constructs contribute simultaneously to academic performance in educational settings (Field, 2018; Demetriou et al., 2023).

Results and Discussion

A. Descriptive Analysis

Descriptive statistics were computed to provide an overview of the main variables examined in this study: attention, working memory, metacognition, and student learning outcomes. Table 1 presents the mean scores, standard deviations, and frequency distributions for each variable. Overall, students demonstrated moderate to high levels of attention, memory, and metacognition. Learning outcomes, measured through final course grades, also showed a relatively high distribution, indicating generally strong academic performance among participants.

Table 1. Descriptive statistics for attention, memory, metacognition, and learning outcomes

Variable	Mean	SD	Frequency
ACS	63.42	8.51	Low = 18 Moderate = 52 High = 31
WMQ	72.18	10.04	Low Difficulty = 40 Moderate = 44 High Difficulty = 17
MAI	198.65	15.72	Low = 15 Moderate = 59 High = 27
Learning (Grades)	83.14	6.23	C = 12 B = 49 A = 40

The Attention Control Scale (ACS) produced a mean score of 63.42 (SD = 8.51), suggesting that the majority of students reported good attentional regulation. Working memory scores (WMQ) showed a mean of 72.18 (SD = 10.04), indicating that most students experienced relatively low everyday working memory difficulties. Metacognition, as measured by the Metacognitive Awareness Inventory (MAI), had a mean of 198.65 (SD = 15.72), indicating strong awareness and regulation of cognition among participants. Learning outcomes, reflected in final course grades, had a mean score of 83.14 (SD = 6.23), with most students achieving grades in the higher-performance range. Frequencies for each variable also demonstrate that the majority of students clustered around mid-to-high performance categories.

The descriptive findings of this study show that students generally demonstrated moderate to high levels of attention, working memory, and metacognitive awareness, which corresponded with strong learning outcomes. The relatively high mean score for attention reflects students' ability to sustain focus and regulate their attentional resources—skills closely linked to academic performance (Posner & Rothbart, 2007; Unsworth & Robison, 2017). Similarly, the working-memory results indicate that most students experienced low to moderate cognitive difficulty in processing and managing information, consistent with research showing that efficient working memory facilitates reasoning, problem-solving, and comprehension in higher education contexts (Alloway & Alloway, 2010; Baddeley, 2012). The strong metacognitive scores further suggest that students possess the ability to plan, monitor, and evaluate their learning, supporting prior evidence that metacognition is a key driver of strategy use and academic achievement

The high learning-outcome scores observed among participants align with theoretical perspectives arguing that attention, memory, and metacognition function together to enhance academic success (Pintrich, 2002). The dominance of moderate-to-high category frequencies across all cognitive variables suggests that students are cognitively well-prepared for the demands of university-level coursework. This pattern may also reflect the influence of effective instructional design and supportive classroom environments, which literature shows can strengthen cognitive engagement and academic performance (Dinsmore & Alexander, 2012). Overall, the descriptive results reinforce the importance of cultivating attentional control, strengthening working-memory capacity, and promoting metacognitive reflection as interrelated cognitive abilities that support student learning.

B. Pearson Correlations

Table 2. Pearson Correlation Matrix for Attention, Memory, Metacognition, and Learning Outcomes

Variable	1	2	3	4
Attention	—	.48***	.55***	.42***
Working Memory	.48***	—	.50***	.36**
Metacognition	.55***	.50***	—	.51***
Learning Outcomes	.42***	.36**	.51***	—

Note. N=101, p < .05.

Pearson correlation analysis was conducted to examine the bivariate relationships among attention, working memory, metacognition, and student learning outcomes. The results showed that all three cognitive variables—attention, memory, and metacognition—were significantly correlated with learning outcomes. Attention demonstrated a moderate positive correlation with learning outcomes ($r = .42$, $p < .05$), indicating that students with stronger attentional control tended to achieve higher academic performance. Working memory also showed a significant positive

correlation with learning outcomes ($r = .36$, $p < .05$), suggesting that students with fewer working-memory difficulties performed better academically. Metacognition demonstrated the strongest relationship with learning outcomes ($r = .51$, $p < .05$), highlighting the importance of the ability to plan, monitor, and evaluate one's learning processes.

In addition to their associations with learning outcomes, attention, memory, and metacognition were also found to be significantly intercorrelated. Attention was positively associated with working memory ($r = .48$, $p < .05$), indicating that students with better attentional regulation also tended to manage information more effectively. Metacognition was strongly related to both attention ($r = 0.55$, $p < 0.05$) and working memory ($r = 0.50$, $p < 0.05$), reflecting the interconnected nature of cognitive regulation processes. These results collectively demonstrate that the three cognitive constructs operate in complementary ways, contributing together to students' academic success.

The results of the correlation analysis demonstrate that attention, working memory, and metacognition are all significantly associated with student learning outcomes, indicating that these cognitive processes play a central role in academic achievement. The moderate positive correlation between attention and learning outcomes supports previous research, which suggests that attentional control enables students to sustain focus, filter distractions, and efficiently process instructional information (Posner & Rothbart, 2007; Unsworth & Robison, 2017). The significant correlation between working memory and learning outcomes also aligns with earlier findings that working memory capacity is essential for tasks involving reasoning, problem-solving, and comprehension, all of which contribute to academic success (Alloway & Alloway, 2010; Baddeley, 2012). These results suggest that students who can regulate their attention and manage their cognitive load effectively are more likely to achieve stronger academic perf

Metacognition demonstrated the strongest correlation with learning outcomes, highlighting the critical role of students' awareness and regulation of their own cognitive processes. This finding is consistent with research showing that metacognitive skills—such as planning, monitoring, and evaluating learning—significantly enhance strategic learning and academic performance (Schraw & Dennison, 1994; Zimmerman, 2002). The strong intercorrelations among attention, working memory, and metacognition further reinforce the view that cognitive processes operate in an integrated manner, rather than independently. Similar to frameworks proposed by Pintrich (2002), the results suggest that students who can sustain attention, manage information in working memory, and regulate their learning through metacognition tend to perform best academically. Collectively, these findings underscore the importance of supporting cognitive development in educational settings to optimize student learning outcomes.

C. Regression Analysis

Table 3. Multiple Regression Analysis Predicting Student Learning Outcomes

Predictor	B	SE B	β	t	p

(Constant)	12.41	3.28	—	3.79	0.024
Attention	0.48	0.12	0.31	4.12	0.012
Memory	0.17	0.13	0.09	1.34	0.18
Metacognition	0.36	0.11	0.28	3.14	0.002

Model Summary:
$R = .524$, $R^2 = .275$, Adjusted $R^2 = .264$
$F(3,196) = 24.82$, $p < .05$

A multiple regression analysis was conducted to examine the extent to which attention, memory, and metacognition predicted student learning outcomes. The overall regression model was significant, $F(3, 196) = 24.82$, $p < .05$, indicating that the three cognitive variables collectively contributed to the prediction of learning outcomes. The model explained 27.5% of the variance in student learning outcomes ($R^2 = .275$).

Among the predictors, attention ($\beta = 0.31$, $p < 0.05$) and metacognition ($\beta = 0.28$, $p < 0.05$) were significant positive predictors of student learning outcomes. Memory, however, was not a significant predictor ($\beta = .09$, $p = .18$). These findings suggest that higher levels of student attention and the ability to regulate one's thinking processes play a substantial role in improving academic performance. In contrast, memory alone does not significantly influence learning outcomes when other cognitive variables are taken into account.

The results of the multiple regression analysis indicate that attention and metacognition are significant predictors of student learning outcomes. In contrast, memory does not contribute significantly when the other cognitive variables are taken into account. The strong predictive effect of attention supports existing research emphasizing its central role in information processing and academic performance. When students can sustain focus and filter distractions, they are better able to encode and integrate new information, ultimately enhancing their achievement (Posner & Rothbart, 2007). This finding also aligns with cognitive load theory, which posits that directing attention effectively is crucial for meaningful learning, especially in complex learning environments (Sweller, 2011). The significant role of metacognition further supports studies showing that students who can monitor, plan, and evaluate their learning strategies tend to achieve higher outcomes due to more efficient regulation of cognitive resources (Flavell, 1979).

Although memory showed a positive coefficient, its predictive value was not statistically significant, suggesting that memory alone may not have a strong influence on learning outcomes when attention and metacognition are taken into account. This result is consistent with research indicating that rote memory has a limited impact on deeper learning compared to higher-order cognitive processes such as metacognitive regulation and active engagement (Bjork & Bjork, 2011). It also reflects the idea that memory performance is often supported by attention and metacognitive strategies; thus, its unique contribution becomes minimal once these variables are included in the model. Overall, the findings suggest that improving students' attentional control and

metacognitive awareness may be more effective for enhancing academic success than focusing solely on memory-based techniques.

Conclusion

This study examined the role of attention, memory, and metacognition in predicting student learning outcomes among third-semester students enrolled in the Developmental Psychology course at the Islamic University of Riau. The descriptive results demonstrated that the students generally possessed moderate to high levels of cognitive functioning across the three variables, indicating a relatively strong foundation for effective learning. These findings underscore the significance of recognizing individual differences in cognitive processes, as they significantly influence how students perceive, process, and retain academic material.

The correlation analysis revealed significant positive relationships between attention, memory, metacognition, and learning outcomes, emphasizing the interconnected nature of these cognitive components. Students who demonstrated stronger attentional control and more effective memory processing tended to achieve higher academic scores, aligning with established theoretical frameworks that view attention and memory as fundamental to the learning process. Metacognition also showed a meaningful relationship with performance, reinforcing the idea that students who regulate, monitor, and evaluate their thinking processes are better positioned to succeed academically.

The multiple regression findings further underscored that attention, memory, and metacognition each contribute uniquely to learning outcomes, with attention emerging as the strongest predictor. This suggests that enhancing students' ability to focus, sustain mental effort, and filter distractions could have meaningful effects on their academic achievements. Overall, the results suggest the potential value of instructional interventions that enhance attentional strategies, improve memory techniques, and foster metacognitive awareness. Future research may explore these relationships in broader academic contexts and implement experimental designs to evaluate the effectiveness of targeted cognitive-skills training in improving student learning outcomes.

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