

## **The Role of Cognitive Ability in Mediating Active Learning and Learning Discipline on Learning Achievement**

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**Abstract:** This study aims to test the role of cognitive ability in mediating active learning and learning discipline on learning achievement. This research is a quantitative study with practical significance and data collection. The analysis technique used was regression analysis, and Sobel test. The results obtained that active learning has significant positive effect on cognitive abilities. Learning discipline has no effect on cognitive abilities. Active learning has no effect on learning achievement. Learning discipline has significant positive effect on learning achievement. Cognitive ability has no effect on learning achievement. Cognitive ability does not function to mediate active learning and learning discipline on learning achievement. The findings suggest prioritizing learning discipline to enhance learning achievement while focusing on active learning to boost cognitive abilities, providing actionable insights for educators and policymakers. The novelty lies in this integrated and region specific exploration that challenges existing educational theories and provides tailored insights for practical implementation. The research contributes to understanding the nuanced relationships between active learning, discipline, cognitive ability, learning achievement among sixth grade students. It provides actionable insights for educators, policymakers, and future researchers to develop more holistic strategies for enhancing learning achievement.

**Keywords:** Active Learning, Cognitive Ability, Learning Achievement, Learning Discipline

### **A. Introduction**

Active learning involves student participation through activities and discussions, promoting higher order thinking skills. According to (Smith & Tanner, 2010), problem based learning in student centered classrooms has a positive effect on academic achievement. Additionally, (Simba\* & John Odwar Agak and Eric K. Kabuka, 2016) found that learning discipline plays a crucial role in improving academic performance, emphasizing its importance in the educational process. Cognitive ability which include memory, representation, information processing, logical reasoning, and thinking conversion are also significant contributors to

academic achievement. Research by (Shi & Qu, 2022) demonstrated that cognitive abilities have a positive and significant influence on academic outcomes.

While some studies confirm the positive impact of cognitive abilities on academic achievement, other research contradicts this. For instance, (Tikhomirova et al., 2020) found no significant relationship between cognitive abilities and academic achievement, creating a gap in understanding. Similarly, the extent to which cognitive ability mediates the relationship between active learning, learning discipline, and academic achievement remains unclear. These inconsistencies highlight the need for further investigation to clarify these relationships.

This study builds on existing frameworks by examining the mediating role of cognitive abilities in elementary school contexts, particularly at the sixth grade level. Previous studies, such as those by (Smith & Tanner, 2010) and (Simba\* & John Odwar Agak and Eric K. Kabuka, 2016) focused primarily on direct relationships while recent efforts by (Tikhomirova et al., 2020) and (Shi & Qu, 2022) explored cognitive variables more deeply. By integrating these perspectives, this research employs advanced statistical techniques, such as Sobel tests and regression models to explore mediating effects with a focus on West Semarang District.

The novelty of this study lies in its unique focus on sixth grade elementary students in West Semarang District that a demographic that has not been extensively studied. Unlike prior research that primarily explored direct effects, this study investigates the mediating role of cognitive abilities between active learning, learning discipline, and academic achievement. This angle is unique because it goes beyond traditional linear relationship to examine how cognitive processes act as potential intermediaries, revealing the underlying mechanism of how learning strategies and behaviors influence achievement (He et al., 2017). It compares the direct and indirect effects of active learning (a student centered pedagogical approach) (Auerbach & Andrews, 2018) and learning discipline (a behavioral construct) on cognitive ability and learning achievement. Highlighting how these constructs differ in their pathways and influences is relatively underexplored in prior research. The study emphasize the interplay between cognitive and no cognitive skills, contributing to the growing recognition of holistic approaches to academic success. It provides practical implications for balancing student centered learning approaches, disciplined behaviors, and cognitive skill development. This holistic view can guide educators and policymakers in designing more effective interventions and depth to understanding the variability in academic outcomes across different educational settings. This study sheds light on why active learning, despite its effectiveness in enhancing cognitive engagement, may not directly translate into higher academic achievement. This calls for reevaluation of assessment methods and alignment between active learning strategies and evaluation practices (Alonso-tapia, 2006).

Furthermore, this research contributes to resolving contradictions in previous finding by examining cognitive abilities role in the interplay of these variables. Otherwise, this research is refined understanding of active learning's impact that prior research has extensively highlighted the benefits of active learning in enhancing cognitive engagement. This study delineates its specific impact on cognitive ability and its limited direct contribution to learning achievement. As reassessment of learning discipline's role, it unlikes many studies that position discipline as a foundational driver of both cognitive and academic outcomes, this challenges conventional assumptions and shifts focus toward the non cognitive pathways through which discipline contributes to success. Questioning cognitive ability as a mediator to determinant of academic success. As contextualizing findings within educational systems that the study highlights systemic misalignments, such as the focus on rote memorization and compliance in traditional assessments which may limit the translation of cognitive skills into measurable achievement. By advocating for performance based assessments and motivational strategies, and contribute to ongoing debates about educational reform. This aligns with (E. Adams, 2015) Bloom's Taxonomy and underscores the need for a balanced approach that nurtures cognitive, affective, and psychomotor domains. This research emphasize the complexity of educational outcomes and the importance of integrating cognitive and non-cognitive dimensions for student success. The study proposes that reliance on either active learning or discipline in isolation is insufficient. Instead, a holistic approach that combines intellectual engagement, structure discipline, and socio emotional learning is essential for well-rounded student development.

This study contributes to educational theory and practice by identifying mechanism through which active learning and discipline influence academic outcomes. It provides educators with insights on how to enhance learning achievement by fostering cognitive skills. Additionally, it addresses research gaps by clarifying the inconsistent findings on cognitive abilities and their mediating role in academic success. Methodologically, it offers a comprehensive framework for analyzing complex relationships in education. Aligning active learning strategies with performance-based assessments may better capture their potential impact on academic achievement. The importance of cultivating consistent behaviors, time management, and perseverance in students. Schools and policymakers should implement programs that foster self-discipline (A Khatun, 2018), as it directly contributes to academic success by creating structured and focused learning environments. It needs to focus on cognitive factors such as emotional intelligence (Deary et al., 2007), motivation, and interpersonal skills (Gamiao & Ph, 2021), which play an equally critical role in holistic student development. Educational systems must adopt holistic strategies that integrate cognitive, emotional, and behavioral development. Guidance for future research to investigate external factors (e.g. socioeconomic background, teaching methods, and classroom dynamics) that may influence the relationships between active learning, discipline, and learning achievement. Explore the role of non-cognitive skills (e.g. emotional intelligence and

self-regulation) as mediators in educational outcomes. Examine the effects of integrated educational interventions that combine active learning, discipline, and motivation to enhance both cognitive and no cognitive domains. Overall, the first one is as curriculum development that educational systems should design curricula that balance cognitive engagement with structured behavioral interventions, ensuring students receive well rounded development. The second one is as teacher training that teacher should be trained to implement active learning strategies effectively, focusing on engaging students cognitively while also fostering disciplined learning environments. The third one is as policy recommendations that policymakers should encourage schools to adopt holistic (Rybska & Błaszak, 2020) teaching methods and performance based assessment models that better capture the benefits of active learning.

This research contributes to the growing understanding of the complexities of educational outcomes, highlighting the dominant role of discipline in learning achievement and the nuanced impacts of active learning and cognitive ability. Does cognitive ability mediate the effect of active learning and learning discipline on the learning achievement of sixth grade elementary school students in West Semarang District?

## **B. Methods**

This research is a quantitative study that emphasizes practical significance and utilizes data collection and analysis methods aligned with the research questions (Ishtiaq, 2019) and (Albers, 2017). The steps included identifying the problem, formulating hypotheses, selecting the sample, collecting data using structured instruments, and analyzing the data. Each step was conducted systematically to ensure the validity and reliability of the findings (Gomes Junior et al., 2020).

The population this study consisted of sixth grade elementary school students in Semarang City. From this population, a purposive sample of 120 students in West Semarang District was selected. However, only 110 valid responses were collected due to incomplete data submissions. This district was chosen because of its diverse demographic and educational characteristics, which provide a representative sample for examining the research variables (Gay, 1992).

The analysis involved several stages. Descriptive analysis was used to summarize data trends and respondent characteristics (D'Andrea & Wooten, 2017). Assumption tests, including normality and heteroscedasticity tests were performed to verify the data met the requirements for regression analysis. Regression analysis was conducted to examine the direct relationships between variables while Sobel tests (Soleman & Tiffanie Victoria, 2021) were used to assess the mediating role of cognitive abilities (Mohanty et al., 2020). Model testing included the F-test and the R-square test. The F-test was employed to determine the model's goodness of fit where

a significance value (sig.) of  $<0.05$  indicated the model was appropriate (ElNakib et al., 2021). The R-square test evaluated the proportion of variance in the dependent variable explained by the independent variables. Hypothesis testing utilized t-tests to determine the significance of relationships, considering both the significance value ( $<0.05$ ) and the sign of the beta coefficient (positive or negative). Hypotheses were accepted or rejected based on these results (McNabb, 2018).

### **C. Results and Discussion**

Analysis of cognitive ability (Y1) as the dependent variable that a function of active learning (X1) and learning discipline (X2). The first regression of model F statistic is highly significant  $F = 158.702$  at  $p < 0.05$  (0.000), it means that meet of goodness of fit, with an adjusted R-square value of 0.743, indicating that 74.3% of the variance in cognitive ability is explained by the predictors. Active learning (X1) as a predictor of cognitive ability that the regression coefficient for active learning (X1) is 0.870 which is significant at  $p < 0.05$ . It means that active learning (X1) significantly and positively affects cognitive ability (Y1), it's proven on H1 accepted that  $p < 0.05$ . According to (Genovese, 2003) and (van der Veer, 2020), active engagement is essential for cognitive development. Active learning techniques, such as problem solving, collaborative activities, and hands on experiments, stimulate critical thinking and the construction of knowledge. (Sweller, 1988) explained that active learning reduces cognitive load by allowing students to process and internalize information through meaningful activities. The strong influence of active learning (X1) on cognitive ability (Y1) is emphasizing the need for student centered approaches in educational practices. While analysis learning discipline (X2) as a predictor of cognitive ability. The coefficient for learning discipline (X2) is -0.016, which is not statistically significant. Learning discipline (X2) does not significantly affect cognitive ability (Y1), it's proven on H2 rejected that  $p > 0.05$ . (Zimmerman & Risemberg, 1997) argues that while discipline enhances focus and time management, cognitive skills are primarily driven by mental engagement and intellectual stimulation, it does not inherently enhance cognitive development. The lack of significance here suggests that cognitive growth depends more on quality of learning than behavioral discipline. The regression equation for cognitive ability (Y1) emphasizes the dominant role of active learning in shaping cognitive ability while highlighting the negligible impact of discipline.

Analysis of learning achievement (Y2) as the dependent variable that a function of active learning (X1), learning discipline (X2), and cognitive ability (Y1). On the second regression of model F statistic is significant  $F = 26.840$  at  $p < 0.05$  (0.000) it means that meet of goodness of fit, with an adjusted R-square value of 0.416, indicating that 41.6% of the variance in learning achievement is explained by the predictors. Active learning (X1) as a predictor of learning achievement that regression of coefficient for active learning (X1) is 0.120 which is not statistically significant. It means that active learning (X1) does not significantly affect learning

achievement (Y2), it's proven on H3 rejected that  $p > 0.05$ . As indirect effects of while active learning enhances cognitive ability, its impact on achievement may require additional mediators, such as motivation or alignment with assessment methods. (Biggs, 2003) posits that traditional assessments often measure rote learning rather than the critical thinking skills fostered by active learning. It needs for educational systems to integrate active learning with performance based assessments to capture more benefits. Learning discipline (X2) as a predictor of learning achievement that regression of coefficient for learning discipline (X2) is 0.627 which is significant at  $p < 0.05$ . It means that learning discipline (X2) significantly and positively affects learning achievement (Y2), it's proven on H4 accepted that  $p < 0.05$ . (Dunn & Zimmer, 2020) highlight the role of discipline in fostering intrinsic motivation which drives persistence and goal achievement. (Catania, 1984) Skinner's operant conditioning theory (elmakrufi, 2013) emphasizes the importance of consistent behaviors and routines in achieving academic success (Schlinger, 2021). Discipline creates the structure and habits necessary for sustained academic effort, explaining its strong influence on achievement. Cognitive ability (Y1) as a predictor of learning achievement that regression of coefficient for cognitive ability (Y1) is -0.054 which is not statistically significant. It means that cognitive ability (Y1) does not significantly influence learning achievement (Y2), it's proven H5 that  $p > 0.05$ . (O'Brien & Burnett, 1997) explained that academic success is influenced by various intelligences beyond the cognitive domain such as interpersonal and intrapersonal skills. (Mahmoudi et al., 2012) suggests learning achievement depends on a combination of cognitive, emotional, and behavioral factors (Rybska & Błaszak, 2020). The lack of a significant relationship between cognitive ability (Y1) and learning achievement (Y2) highlights the complexity of academic success. The regression equation of learning achievement (Y2) emphasizes the dominant role of discipline in predicting achievement while highlighting the limited contributions of active learning (X1) and cognitive ability (Y1). The details shown into the result of regression test on table 1.

**Table 1. The Result of Regression Test**

Regression Test	Results
Dependent Cognitive Ability (Y1)	F = 158.702*** Adj.R_Squre = 0.743 X1 = 0.870*** X2 = - 0.016
Equation	$Y_1 = a + 0.870X1 - 0.016X2$
Dependent Learning Achievement (Y2)	F = 26.840*** Adj.R_Squre = 0.416 X1 = 0.120 X2 = 0.627*** Y1 = -0.054
Equation	$Y_2 = a + 0.120X1 + 0.627X2 - 0.054Y1$

Cognitive ability (Y1) as a mediator between active learning (X1) and learning achievement (Y2) shown Sobel test results is  $Z = -0.4881$  and  $p = 0.6255$ , it is not

significant at  $p < 0.05$  whereas indirect effect value is  $-0.0737$  with confidence intervals  $[-0.3697, 0.2223]$ , it is showing no significant mediation. The results suggest that cognitive ability variable (Y1) does not mediate the relationship between active learning (X1) and learning achievement (Y2). The effect of active learning on learning achievement does not operate through cognitive ability. Active learning (X1) positively influences cognitive ability (as seen in Table 1). However, the transfer of cognitive skills into measurable academic outcomes (Y2) might be limited due to other external factors like assessment design, instructional alignment, and student motivation. According to Bloom's Taxonomy (E. Adams, 2015) that academic achievement encompasses not only cognitive skills but also affective and psychomotor domains. Active learning (X1) may predominantly affect the cognitive domain (e.g., problem solving and critical thinking) but might not fully translate into better academic grades. The lack of mediation could also reflect traditional educational environments where assessments prioritize rote memorization or compliance over critical thinking skills cultivated by active learning (X1).

The findings highlight the need for integration of active learning with assessments in educational systems must adapt assessment strategies to evaluate the outcomes of active learning effectively and through holistic learning approaches is active learning should be paired with strategies that address other dimensions of learning achievement, such as motivation, discipline, and social skills. The details shown into the result of Sobel test on table 2.

**Table 2. The Result of Sobel Test on The Active Learning Variable (X1)**

Indirect Effect and Significance Using Normal Distribution						
	Value	s.e.	LL 95 CI	UL 95 CI	Z	Sig (two)
Effect	-0.0737	0.1510	-0.3697	0.2223	-0.4881	0.6255
Fairchild et al. (2009) Variance in Y Accounted for by Indirect Effect						0.0510

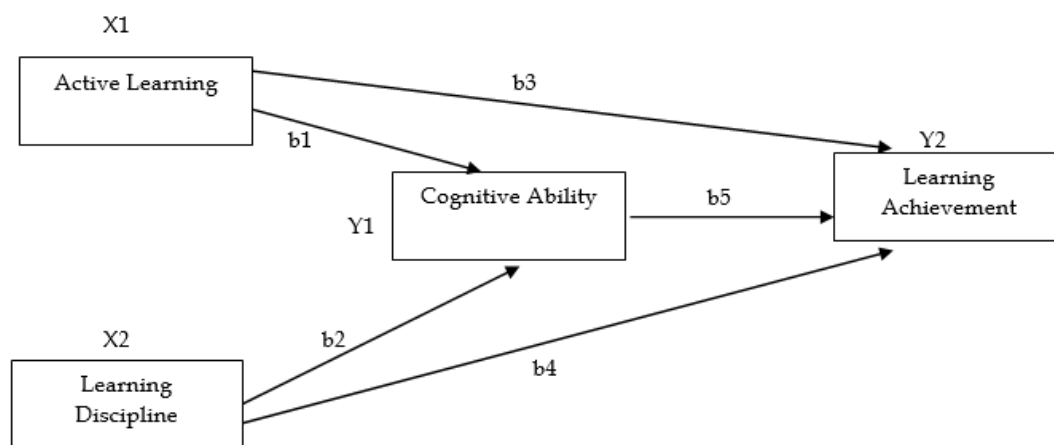
Cognitive ability (Y1) as a mediator between learning discipline (X2) and learning achievement (Y2) shown Sobel test results is  $Z = 0.5540$  and  $p = 0.5796$ , it is not significant at  $p < 0.05$  whereas indirect effect value is  $0.0112$  with confidence intervals  $[-0.0283, 0.0507]$ , it is showing no significant mediation. The results suggest that cognitive ability variable (Y1) does not mediate the relationship between learning discipline (X2) and learning achievement (Y2). As seen in Table 1, learning discipline (X2) has a direct and significant positive effect on learning achievement (Y2). This suggests that disciplined behaviors, such as time management, focus, and perseverance, directly contribute to academic outcomes without requiring significant mediation through cognitive ability. Discipline reflects behavioral consistency rather than cognitive processing. According to (Nabavi & Bijandi, 2024) Bandura's Social Learning Theory emphasizes that disciplined behaviors often stem from observed and reinforced habits which directly translate into better performance without requiring intermediary cognitive development. Cognitive ability is one of many factors contributing to academic success. Discipline likely affects achievement

through non-cognitive pathways, such as emotional regulation, task persistence, and reduced distractions. The findings emphasize behavioral interventions that schools focus on fostering disciplined behaviors. The details shown into the result of Sobel test on table 3.

**Table 3. The Result of Sobel Test on The Learning Discipline Variable (X2)**

Indirect Effect and Significance Using Normal Distribution						
	Value	s.e.	LL 95 CI	UL 95 CI	Z	Sig (two)
Effect	0.0112	0.0202	-0.0283	0.0507	0.5540	0.5796
Fairchild et al. (2009) Variance in Y Accounted for by Indirect Effect						0.0512

The mediating model on Figure 1.



**Figure 1. The Mediating Model**

To support and contextualize these findings, here are insights from previous studies and literature. Positive effects of active learning on cognitive ability that active learning fosters critical thinking and cognitive engagement (Bonwell & Eison, 1991). A study by (Prince, 2004) confirmed that active participation enhances memory retention (Halford & McCredden, 1998). Research by (Freeman et al., 2014) demonstrated improved learning outcomes in students exposed to active learning. Active learning strategies such as discussions and problem solving tasks, stimulate cognitive processing (Simba\* & John Odwar Agak and Eric K. Kabuka, 2016) that supported such findings to emphasize that engaging students actively boosts their ability to process and retain information. While learning discipline generally correlates with academic success (Seligman & Duckworth, 2005), its direct impact on cognitive ability maybe less significant. (Simba\* & John Odwar Agak and Eric K. Kabuka, 2016) found that learning discipline plays a crucial role in improving academic performance, emphasizing its importance in the educational process (Stanley, 2014). (Wolters & Hussain, 2015) suggest that self regulation plays a stronger role in cognitive outcomes compared to external discipline. (A Khatun,



2018) suggests that good discipline creates a good image of the schools and prepares learners for their future life (Eduard et al., 2023).

Contrasting findings by (Smith & Tanner, 2010) suggest that active learning significantly impacts academic performances, highlighting possible contextual differences, this study does not. Differences may arise from varying educational systems, student demographics, or methodological approaches. The lack of a significant effect in this study aligns with findings from (Kirschner et al., 2006) who argue that active learning sometimes overwhelm without proper scaffolding. Learning discipline has consistently been linked to better academic performance (Zimmerman & Risemberg, 1997), a disciplined environment may provide the structure necessary for cognitive activities but does not inherently enhance cognitive development. (Simba\* & John Odwar Agak and Eric K. Kabuka, 2016) and (Shi & Qu, 2022) both highlight discipline's role in maintaining consistent effort and focus which directly correlates with academic success. This study confirms discipline's crucial role especially in structured settings like elementary schools. Studies by (Linnenbrink & Pintrich, 2006) highlight the role of self discipline in sustaining motivation and achievement. Findings by (Aji & Khan, 2019) and (Sasikumar, 2018) indicated that the performance of students with the active learning improved.

Despite prior research (Shi & Qu, 2022) suggesting a positive link, this study aligns with (Tikhomirova et al., 2020) revealing no significant relationship. Possible reasons include the influence of external variables such as teaching methods or socio economic factors, which might overshadow cognitive abilities in elementary students. Prior studies (Sternberg & Zhang, 2014) emphasize that cognitive ability is just one of many factors influencing academic performance. (Robbins et al., 2004) found that non cognitive skills like motivation and perseverance often outweigh cognitive ability in predicting achievement. The lack of a mediating role aligns with studies by (Mayer et al., 2004) which argue that learning processes often bypass cognitive ability as a mediator under certain conditions. Study by (Gamiao & Ph, 2021) indicated that cognitive ability does not predictive of academic performances. (Freeman et al., 2014) found that active learning universally improves academic performances, contrasting with this study's findings on its lack of significance. In contrast to this study, (Seligman & Duckworth, 2005) demonstrated that self discipline directly enhances cognitive and academic outcomes. Sobel's findings in this study contradict the results by (Deary et al., 2007) which highlight cognitive ability as a crucial mediator in education.

#### **D. Conclusions**

Cognitive ability (Y1) as a dependent variable analysis reveals that active learning (X1) significantly and positively influences cognitive ability (Y1), as evidenced by a regression coefficient of 0.870 ( $p < 0.05$ ). This finding highlights the importance of student-centered approaches in education to enhance cognitive outcomes. Learning

discipline (X2) does not significantly impact cognitive ability (regression coefficient of -0.016,  $p > 0.05$ ), it is rejecting H2. Although discipline may support the learning environment, it does not inherently drive cognitive growth. Learning achievement (Y2) as a dependent variable that the regression analysis for learning achievement (Y2) shows that active learning (X1) has no significant direct effect (regression coefficient is 0.120,  $p > 0.05$ ), leading to the rejection of H3. The finding highlights the need for educational systems to integrate active learning with performance based assessments to capture its full potential. In contrast, learning discipline (X2) significantly and positively influences learning achievement (regression coefficient is 0.627,  $p < 0.05$ ), supporting H4. It consistent routines and focused behaviors contribute to academic success. Interestingly, cognitive ability (Y1) does not significantly impact learning achievement (regression coefficient is -0.054 and  $p > 0.05$ ), it is rejecting H5. Cognitive ability alone may not be sufficient to predict achievement, it is highlighting the complexity of academic outcomes. The Sobel test results indicate that cognitive ability (Y1) does not mediate the relationship between active learning (X1) and learning achievement (Y2),  $Z = -0.4881$  and  $p = 0.6255$  or between learning discipline (X2) and learning achievement (Y2),  $Z = 0.5540$  and  $p = 0.5796$ . These findings suggest that the effects of active learning and discipline on achievement do not operate through cognitive ability. These finding underscore the complexity of educational outcomes and the need for a holistic approach to learning. Active learning should be paired with performance based assessments and motivational strategies to maximize its impact on achievement. Meanwhile, fostering discipline remains critical for creating structured learning environments that support sustained effort and goal attainment. However, over reliance on discipline without addressing intellectual engagement may limit its long term effectiveness. The lack of a significant relationship between cognitive ability and academic achievement highlights the need to consider non cognitive factors, such as emotional intelligence, self regulation, and social skills. Educational systems must balance cognitive and non cognitive development to support well rounded student growth.

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