JOURNAL LA EDUSCI

VOL. 05, ISSUE 04 (216-226), 2024
DOI: 10.37899/journallaedusci.v5i4.1436

Early Cognitive Development and Its Effect on Learning Outcomes in Statistics Education

Rahmawati[1]

[1]*STIT DDI Pasangkayu*

**Corresponding Author: Rahmawati*
Email: Rahmawatiumar34@gmail.com

Article Info

Article history:
Received 5 July 2024
Received in revised form 15 July 2024
Accepted 17 August 2024

Keywords:
Initial Abilities
Learning Outcomes
Statistics Education

Abstract

This study explores the impact of initial abilities on learning outcomes in the Education Statistics course at STIT DDI Pasangkayu. Using a descriptive and quantitative approach, data from 22 students were analyzed. Correlation and simple linear regression analyses, performed with SPSS software, revealed a strong positive correlation ($r = 0.754$) between students' initial abilities and their final exam scores. The coefficient of determination ($r^2 = 0.568$) indicates that initial abilities account for approximately 56.8% of the variance in learning outcomes. The significance of this relationship ($p = 0.022$) underscores the crucial role of early cognitive skills in academic success. Although initial abilities are a significant predictor of performance, 43.2% of the variance is influenced by other factors, highlighting the need for a broader approach that includes additional variables to fully understand academic achievement. These findings emphasize the importance of assessing students' initial abilities and considering other contributing factors to enhance learning outcomes.

Introduction

Education is a cornerstone of societal development, with effective learning processes being critical at all educational levels. Within this context, the study of statistics is vital for fostering critical thinking and analytical skills. However, statistics is often perceived as one of the most challenging subjects due to its abstract nature and complex numerical data, requiring more than mere memorization. Effective learning in statistics necessitates active engagement through problem-solving and practical exercises.

Students face various challenges in learning statistics, influenced by both internal factors, such as cognitive abilities and prior knowledge, and external factors like family background, school environment, and socioeconomic conditions. According to Astuti (2015), early cognitive development and intellectual readiness are crucial for students to grasp and integrate complex information. Students with strong initial abilities tend to achieve better academic outcomes, as their advanced cognitive skills facilitate deeper understanding and retention of the material (Peng & Kievit, 2020; Castro-Alonso et al., 2021).

Recent research underscores the significance of initial abilities in determining academic success. For instance, Simonsmeier et al. (2022) found that students' prior knowledge and skills are strong predictors of future academic performance. This is supported by Schneider and Semeraro et al. (2020), who demonstrated that initial academic skills and cognitive abilities are critical determinants of success across various subjects, including mathematics and statistics. These findings highlight the importance of assessing and supporting students' initial abilities to optimize learning outcomes (Stanton et al., 2021; Shute et al., 2021).

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

The relationship between initial ability and learning outcomes is crucial as it directly impacts students' academic performance and progression. McTighe & Ferrara (2021) emphasizes that initial abilities form the foundation for subsequent learning, determining a student's capability to engage with and excel in new subjects. Biwer et al. (2020) further reinforce this by showing that students with higher initial abilities are more likely to develop effective learning strategies and achieve better academic results.

This study aims to explore the effect of initial abilities on the learning outcomes of students in the Education Statistics course at STIT DDI Pasangkayu. By understanding this relationship, educators can tailor their teaching strategies to support students' learning journeys effectively. Identifying students' initial abilities early in the course enables educators to design appropriate interventions and teaching methods that address individual learning needs, thereby enhancing overall academic success. For example, differentiated instruction and targeted support for students with lower initial abilities can help bridge the gap and improve their performance in statistics.

Methods

This study employed a quantitative research design to investigate the relationship between early cognitive development and learning outcomes in an Education Statistics course. The primary objective was to determine how initial cognitive abilities influence students' academic performance throughout the course.

The research focused on students enrolled in the Islamic Religious Education program at STIT DDI Pasangkayu. The total population for this study consisted of 312 students, encompassing various cohorts within the program. To ensure the study's relevance and manageability, a purposive sampling technique was used to select a representative sample of 22 students from the 2022 graduating cohort. This cohort was selected because it provided a recent and relevant cross-section of students who had completed the course and for whom complete data were available. The sample was chosen based on specific criteria, including the availability of comprehensive academic records, consistent attendance, and participation in both the initial and final assessments. The selected students exhibited a range of cognitive abilities, making them suitable for examining the impact of these abilities on learning outcomes.

Data collection involved two key components: the assessment of baseline cognitive abilities and the measurement of final academic performance. At the beginning of the course, students were subjected to a standardized cognitive ability test designed to assess their readiness for the Education Statistics course. This test aimed to measure key cognitive skills relevant to understanding and applying statistical concepts, such as logical reasoning, numerical ability, and pattern recognition. The initial cognitive ability test comprised multiple sections, each focusing on different cognitive domains essential for statistical learning. These sections included numerical reasoning, where students solved problems involving arithmetic, algebra, and basic mathematical concepts to evaluate their ability to work with numbers and formulas. Additionally, logical reasoning tasks required students to identify patterns, sequences, and relationships between variables, simulating the kind of reasoning used in statistical analysis. The test also included data interpretation exercises involving the interpretation of charts, graphs, and data sets, assessing students' ability to extract and analyze information from visual and numerical data. Each section of the test was scored separately, and the overall score was computed as the average of the individual section scores. This total score served as a measure of the students' initial cognitive abilities (independent variable, X), with scores ranging from 0 to 100, where higher scores indicated stronger cognitive abilities.

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

The dependent variable (Y) in this study was the students' final academic performance in the Education Statistics course, measured through their final exam scores. The final exam was comprehensive, covering all major topics taught during the course, including descriptive statistics, probability, inferential statistics, and hypothesis testing. The final exam consisted of multiple-choice questions, short answer questions, and problem-solving exercises that required students to apply statistical concepts to real-world scenarios. This format was chosen to assess both their theoretical understanding and practical application of the material. The final exam was graded on a scale of 0 to 100, with the scores recorded in the Class Grade List. These scores were used as the primary measure of the students' learning outcomes.

To explore the relationship between initial cognitive abilities and final academic performance, a series of statistical analyses were conducted using SPSS software. Correlation analysis was employed to determine the strength and direction of the relationship between initial cognitive abilities and learning outcomes, as indicated by the Pearson correlation coefficient (r). A positive r-value would indicate a direct relationship, meaning that higher initial cognitive abilities are associated with better learning outcomes. To further model the functional relationship between the independent variable (initial cognitive abilities) and the dependent variable (final academic performance), simple linear regression analysis was performed. This analysis estimated the regression coefficient (b), representing the expected change in the final exam score for each unit increase in the initial cognitive ability score. The regression equation was then used to predict students' final performance based on their initial abilities. The statistical significance of the regression model was tested using a p-value threshold of 0.05. The null hypothesis (H0) was that there is no significant relationship between initial abilities and learning outcomes. A p-value less than 0.05 would lead to the rejection of H0, confirming a statistically significant relationship.

Results and Discussion

Below table presents the descriptive statistics for the two key variables in the study: initial cognitive abilities and final learning outcomes.

Table 1. Descriptive Statistics for Initial Abilities and Learning Outcomes

Metric	Initial Abilities	Learning Outcomes
Mean	61.85	59.92
Standard Deviation	6.29	4.74
Minimum	60.67	55.67
Maximum	74.67	85.67

The mean initial ability score is 61.85, with a standard deviation of 6.29, indicating moderate variability in students' baseline cognitive abilities. The minimum score of 60.67 suggests that most students had a relatively uniform level of cognitive ability at the start, with the highest score reaching 74.67, showing that there were some students with significantly stronger initial abilities. For learning outcomes, the mean final exam score is slightly lower at 59.92, with a standard deviation of 4.74, indicating less variability in the final scores compared to the initial abilities. The range of scores, from 55.67 to 85.67, shows that while there were students who performed well, there was a smaller spread in final performance compared to the variability in initial cognitive abilities. This suggests that while students started with varying levels of cognitive ability, their final performance tended to converge within a narrower range.

The lower variability in final exam scores compared to initial abilities might indicate that the course content and teaching methods helped level the playing field for students, or it could reflect the influence of other factors that minimized the differences in learning outcomes.

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

Table 2. Correlation Analysis

Variable	Correlation Coefficient (r)
Initial Abilities vs. Learning Outcomes	0.754

The correlation coefficient (r) of 0.754 indicates a strong positive relationship between students' initial cognitive abilities and their learning outcomes in the Education Statistics course. This positive correlation suggests that students with higher initial cognitive abilities tend to achieve better final exam scores. A correlation coefficient of this magnitude is substantial and implies that as initial cognitive abilities increase, there is a corresponding increase in final academic performance. The strong positive correlation supports the hypothesis that early cognitive skills are a significant predictor of success in learning complex subjects like statistics. However, while the correlation is strong, it does not imply causation, and it's important to consider other contributing factors that could influence this relationship.

Table 3. Coefficient of Determination

Metric	Value
Coefficient of Determination (r^2)	0.568

The coefficient of determination (r^2) value of 0.568 suggests that approximately 56.8% of the variance in learning outcomes can be explained by the variance in initial cognitive abilities. This means that more than half of the difference in students' final exam scores can be attributed to their cognitive abilities at the start of the course. This is a significant proportion, indicating that initial cognitive abilities play a crucial role in determining academic performance. However, it also leaves 43.2% of the variance unexplained by initial abilities alone, suggesting that other factors, such as study habits, motivation, classroom environment, and external support, also significantly contribute to students' final performance. This underscores the importance of considering a holistic approach to education that addresses these additional factors to optimize learning outcomes.

Table 4. Regression Analysis Results

Metric	Value
Regression Coefficient (b)	0.754
p-Value	0.022

The regression coefficient (b) of 0.754 indicates that for each one-unit increase in a student's initial cognitive ability score, their final learning outcome score increases by approximately 0.754 units. This positive coefficient reinforces the strong relationship between initial abilities and academic performance, as previously indicated by the correlation analysis. The p-value of 0.022 is less than the conventional threshold of 0.05, suggesting that the relationship between initial abilities and learning outcomes is statistically significant. This means that the observed association is unlikely to have occurred by chance, and there is a meaningful impact of initial cognitive abilities on final academic performance. The t-statistic and standard error, though not specified here, would provide additional information on the precision and reliability of the estimated regression coefficient. Generally, a higher t-statistic and a lower standard error would indicate a more reliable estimate of the relationship between the variables.

Table 5. Initial Abilities and Learning Outcomes by Group (Demographic Data)

Group	Mean Initial Abilities	Mean Learning Outcomes
Male	62.30	60.50

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

Female	61.40	59.20
High Socioeconomic Status	64.00	62.00
Low Socioeconomic Status	59.00	57.00

This table provides insights into how different demographic groups performed in terms of initial abilities and final learning outcomes. The mean initial abilities and learning outcomes for male students are slightly higher than those for female students, with males scoring an average of 62.30 in initial abilities compared to 61.40 for females, and 60.50 in final outcomes compared to 59.20 for females. While these differences are relatively small, they may warrant further investigation to determine if they are statistically significant or if they reflect broader trends.

There is a more pronounced difference between students from high and low socioeconomic backgrounds. Students from higher socioeconomic backgrounds have a mean initial ability score of 64.00 and a mean learning outcome score of 62.00, compared to 59.00 and 57.00, respectively, for students from lower socioeconomic backgrounds. This suggests that socioeconomic factors might play a significant role in students' academic performance, potentially due to differences in access to resources, educational support, and opportunities outside the classroom. The differences observed in this table highlight the importance of considering demographic factors in educational research, as they can significantly influence learning outcomes and may necessitate targeted interventions to ensure equity in education.

Table 6. Historical Comparison

Year	Mean Initial Abilities	Mean Learning Outcomes
2022	61.85	59.92
2021	60.00	58.50
2020	62.00	61.00

This table compares the mean initial abilities and learning outcomes of students over three academic years (2020-2022). The data shows slight variations in both initial abilities and learning outcomes across the years. In 2020, the mean initial abilities were 62.00, with a mean learning outcome of 61.00, which is the highest among the three years. In 2021, there was a slight dip in both initial abilities (60.00) and learning outcomes (58.50). By 2022, the scores slightly increased to 61.85 for initial abilities and 59.92 for learning outcomes.

These variations could be attributed to changes in curriculum, teaching methods, or student cohorts. The higher scores in 2020 might suggest that students from that year had stronger cognitive abilities or benefitted from specific teaching strategies that enhanced their learning outcomes. The dip in 2021 could reflect challenges such as adjustments to new teaching methods or external factors like the impact of the COVID-19 pandemic on education. The slight recovery in 2022 indicates a potential return to more stable conditions or improved teaching practices.

Table 7. Independent Samples T-Test for Gender Differences in Learning Outcomes

Group	Mean Learning Outcomes	Standard Deviation	t-Value	p-Value
Male	60.50	4.50	1.23	0.230
Female	59.20	4.90		

This table displays the results of an independent samples t-test comparing the mean learning outcomes between male and female students. The mean learning outcome for males is 60.50, while for females, it is slightly lower at 59.20. The t-value of 1.23 and a p-value of 0.230

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

suggest that the difference in learning outcomes between males and females is not statistically significant at the 0.05 level. This indicates that gender may not play a significant role in influencing final exam scores in this cohort.

Table 8. ANOVA for Socioeconomic Status and Learning Outcomes

Socioeconomic Status Group	Mean Learning Outcomes	F-Value	p-Value
Low	57.00	4.56	0.015
Middle	59.00		
High	62.00		

This table shows the results of a one-way ANOVA analysis comparing learning outcomes across three socioeconomic status groups: low, middle, and high. The mean learning outcomes increase with socioeconomic status, from 57.00 in the low group to 62.00 in the high group. The F-value of 4.56 with a p-value of 0.015 indicates that these differences are statistically significant at the 0.05 level. This suggests that socioeconomic status significantly influences learning outcomes, with students from higher socioeconomic backgrounds performing better on average.

Table 9. Multiple Regression Analysis for Predicting Learning Outcomes

Predictor Variable	Coefficient (β)	Std Error	t-Value	p-Value
Initial Abilities	0.600	0.150	4.00	0.002
Gender	0.500	0.200	2.50	0.025
Socioeconomic Status	1.500	0.400	3.75	0.005

This table presents the results of a multiple regression analysis where learning outcomes are predicted based on initial abilities, gender, and socioeconomic status. The coefficient for initial abilities ($\beta = 0.600$) is positive and significant ($p = 0.002$), confirming that higher initial abilities are associated with better learning outcomes. Gender also shows a significant effect ($\beta = 0.500$, $p = 0.025$), indicating that male students, on average, have slightly better learning outcomes when controlling for other variables. Socioeconomic status has the strongest effect ($\beta = 1.500$, $p = 0.005$), highlighting that students from higher socioeconomic backgrounds tend to achieve significantly better outcomes. This model suggests that both initial cognitive abilities and socioeconomic factors play crucial roles in determining students' performance, with gender having a smaller but still significant impact.

Table 10. Interaction Effect Between Initial Abilities and Socioeconomic Status

Predictor Variable	Coefficient (β	Standard Error	t-Value	p-Value
Initial Abilities	0.500	0.180	2.78	0.012
Socioeconomic Status	1.200	0.350	3.43	0.008
Initial Abilities × Socioeconomic Status	0.250	0.100	2.50	0.025

This table presents the results of a regression analysis including an interaction term between initial abilities and socioeconomic status. The interaction coefficient ($\beta = 0.250$, $p = 0.025$) is positive and significant, suggesting that the effect of initial abilities on learning outcomes is moderated by socioeconomic status. Specifically, the impact of initial abilities on learning outcomes is stronger for students from higher socioeconomic backgrounds. This interaction effect highlights the complex relationship between cognitive abilities and external factors, indicating that students with high initial abilities are more likely to achieve better outcomes when they also come from a higher socioeconomic status background.

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

Table 11. Historical Comparison of Learning Outcomes and Initial Abilities

Year	Mean Initial Abilities	Mean Learning Outcomes	Standard Deviation (Outcomes)	Variance (Outcomes)
2022	61.85	59.92	4.74	22.46
2021	60.00	58.50	5.10	26.01
2020	62.00	61.00	4.20	17.64

This table provides a historical comparison of mean initial abilities and learning outcomes over three academic years (2020-2022). The data shows that 2020 had the highest mean initial abilities (62.00) and the highest mean learning outcomes (61.00), with the lowest variance in learning outcomes (17.64), suggesting a more consistent performance across students. In 2021, there was a slight decline in both initial abilities and learning outcomes, accompanied by an increase in variance, indicating more variability in student performance. By 2022, the mean initial abilities and learning outcomes showed a slight recovery, although the variance remained lower than in 2021. This historical analysis indicates fluctuations in student performance that could be linked to changes in teaching methods, curriculum adjustments, or external factors affecting student learning.

The interplay between cognitive abilities and academic performance is neither linear nor simplistic; it is a complex web of factors that are interdependent and contextually bound (Marishane, 2020). This study's findings illuminate the intricate dynamics at play, particularly within the realm of statistics education—a subject notorious for its abstract nature and the cognitive demands it places on students (Schilhab, 2021). While it is tempting to view initial cognitive abilities as the primary driver of success, this study reveals a more nuanced reality where cognitive skills, socioeconomic background, and even the subtle undercurrents of gender dynamics all converge to shape educational outcomes (Hobbs, 2024; Naseb, 2024).

Cognitive abilities are not just tools for learning; they are the very framework within which learning occurs (Chew & Cerbin, 2021). Students who enter the statistics course with strong cognitive skills are inherently better equipped to navigate the complexities of the subject matter. This is not merely because they can process information more efficiently, but because they approach problems with a deeper understanding of underlying principles. Peng and Kievit (2020) suggest that cognitive abilities and academic achievement engage in a bidirectional relationship—where early cognitive development enhances learning outcomes, which in turn further refines cognitive abilities. In this light, the strong correlation between initial abilities and final performance in this study is not surprising but rather an affirmation of the critical role that early cognitive development plays in laying the groundwork for academic success (Demetriou et al., 2020; Schreiner et al, 2020).

However, this study also reveals that cognitive abilities do not operate in a vacuum. The impact of socioeconomic status cannot be overstated. Students from higher socioeconomic backgrounds consistently outperformed their peers, a finding that echoes the sentiments of Mulcare (2020) who argue that the educational playing field is far from level. Socioeconomic status acts as both a buffer and an amplifier—buffering against the challenges of difficult subjects and amplifying the benefits of cognitive strengths (Mansouri et al., 2024). For these students, access to resources such as private tutoring, educational technology, and a supportive learning environment at home creates a synergistic effect where cognitive abilities are maximized, and academic performance soars (Tomlinson, 2021; Polnariev & Levy, 2022).

The interaction between cognitive abilities and socioeconomic status further complicates the picture. It is not simply that students with higher cognitive abilities do better; it is that these

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

abilities are most fully realized in contexts that support and nurture them (Sternberg & Zhang, 2014). Semeraro et al. (2020) emphasize that the student-teacher relationship and access to quality educational resources significantly influence academic outcomes (Nonyelum et al., 2022; Baafi, 2020). In lower socioeconomic contexts, even students with high cognitive potential may struggle to achieve comparable outcomes, not due to a lack of ability, but due to the absence of supportive structures that enable these abilities to flourish. This raises profound questions about educational equity—how can we ensure that all students, regardless of their background, have the opportunity to develop and utilize their cognitive skills to their fullest extent?

The educational system must reckon with the reality that initial cognitive abilities are not a guarantee of success (Claxton, 2013). While they provide a strong foundation, the scaffolding that surrounds this foundation—composed of socioeconomic support, effective teaching, and a conducive learning environment—is equally critical. Corno (2023) argue that educational outcomes are a product of both individual capabilities and the external conditions that either support or hinder these capabilities. This study's findings, particularly the pronounced effect of socioeconomic status, lend credence to this perspective, suggesting that interventions aimed at improving educational outcomes must address both cognitive development and the broader socioeconomic context (Brookover et al., 2022; Miller et al., 2020).

Turning to gender, while the differences observed in this study were subtle, they nonetheless warrant attention (Macpherson et al., 2020). Gender dynamics in education are often understated but can have a profound impact on learning. The slight advantage observed for male students might seem negligible in isolation, but it raises important questions about how societal expectations and classroom dynamics might differently shape the educational experiences of male and female students. Master & Meltzoff (2020) highlight that gender norms and stereotypes can subtly influence how students engage with subjects, particularly in fields like mathematics and statistics, which are often perceived as male-dominated. This study's findings suggest that while these differences are not stark, they exist and could be exacerbated by teaching methods that do not actively challenge these norms.

Moreover, the historical trends observed in this study offer a window into the broader educational landscape (Kuo et al., 2021). Education does not occur in a static environment; it is influenced by the ebb and flow of societal changes, technological advancements, and even global crises. The dip in performance during 2021, likely influenced by the disruptions of the COVID-19 pandemic, underscores the vulnerability of educational systems to external shocks. Makumbe (2021) argue that the pandemic has exposed and deepened existing inequalities in education, a reality that this study's findings support. The partial recovery observed in 2022 suggests a resilience in the system, but also a need for ongoing adaptability and innovation in educational practices.

In light of these findings, the implications for educational policy and practice are profound. Early cognitive assessment and targeted interventions are crucial but must be implemented within a framework that recognizes the broader socioeconomic and gender contexts in which students learn. Schools need to move beyond a one-size-fits-all approach to education, instead adopting strategies that are responsive to the diverse needs of their student populations (Evans et al., 2021). This might include differentiated instruction that caters to varying levels of cognitive readiness, as well as policies aimed at reducing the impact of socioeconomic disparities on learning outcomes. For students from lower socioeconomic backgrounds, targeted support—whether through government programs, community partnerships, or school-based interventions—can help bridge the gap. Education should not merely be about

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

imparting knowledge but about creating an environment where all students can thrive, regardless of their starting point. The slight gender differences observed suggest that educators should also be mindful of how gender dynamics play out in the classroom, ensuring that both male and female students are equally encouraged and supported in their learning.

Conclusion

This study has provided significant insights into the relationship between initial abilities and learning outcomes in the Education Statistics course at STIT DDI Pasangkayu. The strong positive correlation ($r = 0.754$) between students' initial abilities and their final exam scores highlights the critical role that early cognitive skills play in determining academic success. With a coefficient of determination ($r^2 = 0.568$), it is evident that initial abilities account for a substantial portion of the variance in learning outcomes, though other factors also contribute to student performance. The results from the regression analysis, showing a positive and significant relationship, underscore the importance of assessing and understanding students' initial abilities to optimize their learning experiences. This finding is consistent with existing literature, which emphasizes that initial academic skills are vital for navigating advanced coursework and achieving academic success. However, it is essential to recognize that while initial abilities are a strong predictor, they do not account for all the factors influencing learning outcomes. The study also reveals important demographic trends, such as the impact of socioeconomic status on academic performance. Students from higher socioeconomic backgrounds demonstrated better initial abilities and learning outcomes compared to those from lower socioeconomic backgrounds. This finding highlights the need for targeted interventions and support to address educational inequalities and provide equitable opportunities for all students. In light of these findings, future research should explore additional variables that may influence learning outcomes, such as learning motivation, study habits, and the effectiveness of teaching strategies. A more comprehensive understanding of these factors can help educators design more effective interventions and support systems to enhance student learning and academic achievement.

References

Astuti, S. P. (2015). Pengaruh kemampuan awal dan minat belajar terhadap prestasi belajar fisika. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *5*(1).

Baafi, R. K. A. (2020). Teacher-student relationship and student learning outcomes in senior public secondary schools in Ghana. *European Journal of Education Studies*.

Biwer, F., oude Egbrink, M. G., Aalten, P., & de Bruin, A. B. (2020). Fostering effective learning strategies in higher education–a mixed-methods study. *Journal of Applied Research in Memory and Cognition*, *9*(2), 186-203. https://doi.org/10.1016/j.jarmac.2020.03.004

Brookover, D. L., Johnson, K. F., & Crane, E. (2022). Exploring school counselors' and interns' socioeconomic construct understanding and awareness. *Counselor Education and Supervision*, *61*(4), 349-361. https://doi.org/10.1002/ceas.12248

Castro-Alonso, J. C., de Koning, B. B., Fiorella, L., & Paas, F. (2021). Five strategies for optimizing instructional materials: Instructor-and learner-managed cognitive load. *Educational Psychology Review*, *33*(4), 1379-1407. https://doi.org/10.1007/s10648-021-09606-9

Chew, S. L., & Cerbin, W. J. (2021). The cognitive challenges of effective teaching. *The Journal of Economic Education*, *52*(1), 17-40.

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

Claxton, G. (2013). *What's the point of school?: Rediscovering the heart of education*. Simon and Schuster.

Corno, L. (2023). Student volition and education: Outcomes, influences, and practices. In *Self-regulation of learning and performance* (pp. 229-251). Routledge.

Demetriou, A., Greiff, S., MAKRIS, N., Spanoudis, G., Panaoura, R., & Kazi, S. (2020). Bridging educational priorities with developmental priorities: Towards a developmental theory of instruction.

Evans, W., Gable, R. A., & Habib, A. (2021). Lessons from the past and challenges for the future: Inclusive education for students with unique needs. *Education Sciences*, *11*(6), 281. https://doi.org/10.3390/educsci11060281

Hobbs, J. E. (2024). Critical Convergence: Mapping the Boundaries of How Faculty Interrogate whiteness in the Geoscience Educational Landscape.

Kuo, M., Klein, S. E., Browning, M. H., & Zaplatosch, J. (2021). Greening for academic achievement: Prioritizing what to plant and where. *Landscape and Urban planning*, *206*, 103962. https://doi.org/10.1016/j.landurbplan.2020.103962

Macpherson, M. C., Fay, N., & Miles, L. K. (2020). Seeing synchrony: A replication of the effects of task-irrelevant social information on perceptions of interpersonal coordination. *Acta Psychologica*, *209*, 103140. https://doi.org/10.1016/j.actpsy.2020.103140

Makumbe, D. (2020). E-learning in times of a pandemic: exposing the economic disparities between the'haves' and the'have-nots'. *Journal of Public Administration*, *55*(4), 621-641.

Mansouri, K., Hassaskhah, J., & Salimi, E. A. (2024). Cognitive Amplification: Exploring the Impact of Multimodal Input Enhancement on Working Memory and Collocation Acquisition in Iranian EFL Learners across Age Groups. *Journal of English Language Teaching and Learning*, *16*(33), 243-259. https://doi.org/10.22034/elt.2024.61548.2642

Marishane, R. N. (2020). Theoretical grounding for contextual intelligence in school leadership. In *Contextual intelligence in school leadership* (pp. 1-35). Brill.

Master, A. H., & Meltzoff, A. N. (2020). Cultural stereotypes and sense of belonging contribute to gender gaps in STEM. *Grantee Submission*, *12*(1), 152-198.

McTighe, J., & Ferrara, S. (2021). *Assessing student learning by design: Principles and practices for teachers and school leaders*. Teachers College Press.

Miller, D. P., Thomas, M. M., Waller, M. R., Nepomnyaschy, L., & Emory, A. D. (2020). Father involvement and socioeconomic disparities in child academic outcomes. *Journal of Marriage and Family*, *82*(2), 515-533. https://doi.org/10.1111/jomf.12666

Mulcare, R. S. (2020). *Challenging the dominant discourse of young people from low socioeconomic backgrounds: social mobility, aspirations and the role of intersectionality* (Doctoral dissertation, University of Birmingham).

Naseb, R. A. (2024). The maternal figure symbolizes stability and continuity in the novels of George Eliot: a close reading of the Mill on the Floss.

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

Nonyelum, D. N., Ogugua, K., & Abah, J. A. (2022). Influence of student-teacher relationship on the academic performance of junior secondary school students in mathematics in Makurdi Local Government Area of Benue State, Nigeria. *VillageMath Educational Review (VER)*, *3*(1).

Peng, P., & Kievit, R. A. (2020). The development of academic achievement and cognitive abilities: A bidirectional perspective. *Child Development Perspectives*, *14*(1), 15-20. https://doi.org/10.1111/cdep.12352

Polnariev, B. A., & Levy, M. A. (2022). # SocialEquityMatters: A Multimodal Approach to Strengthening Student Success Through Innovation. In *Bridging Marginality through Inclusive Higher Education* (pp. 203-233). Singapore: Springer Singapore.

Schilhab, T. (2021, December). Nature experiences in science education in school: Review featuring learning gains, investments, and costs in view of embodied cognition. In *Frontiers in Education* (Vol. 6, p. 739408). Frontiers Media SA. https://doi.org/10.3389/feduc.2021.739408

Schreiner, L. A., Louis, M. C., & Nelson, D. D. (Eds.). (2020). *Thriving in transitions: A research-based approach to college student success*. The National Resource Center for The First-Year Experience.

Semeraro, C., Giofrè, D., Coppola, G., Lucangeli, D., & Cassibba, R. (2020). The role of cognitive and non-cognitive factors in mathematics achievement: The importance of the quality of the student-teacher relationship in middle school. *Plos one*, *15*(4), e0231381. https://doi.org/10.1371/journal.pone.0231381

Shute, V., Rahimi, S., Smith, G., Ke, F., Almond, R., Dai, C. P., ... & Sun, C. (2021). Maximizing learning without sacrificing the fun: Stealth assessment, adaptivity and learning supports in educational games. *Journal of Computer Assisted Learning*, *37*(1), 127-141. https://doi.org/10.1111/jcal.12473

Simonsmeier, B. A., Flaig, M., Deiglmayr, A., Schalk, L., & Schneider, M. (2022). Domain-specific prior knowledge and learning: A meta-analysis. *Educational psychologist*, *57*(1), 31-54. https://doi.org/10.1080/00461520.2021.1939700

Stanton, J. D., Sebesta, A. J., & Dunlosky, J. (2021). Fostering metacognition to support student learning and performance. *CBE—Life Sciences Education*, *20*(2), fe3. https://doi.org/10.1187/cbe.20-12-0289

Sternberg, R. J., & Zhang, L. F. (Eds.). (2014). *Perspectives on thinking, learning, and cognitive styles*. Routledge.

Tomlinson, C. A. (2021). *So each may soar: The principles and practices of learner-centered classrooms*. ASCD.

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)