https://ddmrmjournal.in
Academic Journal 2025, 18, 26-43

Original Research Article

Exploring the Predictive Value of Metacognition for Academic Outcomes Among Postgraduate Students

Azharuddin Molla[1] and Dr. Ajit Mondal[2]

[1]Research Scholar, Department of Education, West Bengal State University, Kolkata - 700126, West Bengal, India Email: azharuddinmolla711@gmail.com
[2]Assistant Professor, Department of Education, West Bengal State University, Kolkata-700126, West Bengal, India Email: mondalajit.edn@gmail.com

Abstract:
This study explores the predictive value of metacognition in relation to academic outcomes among postgraduate students, focusing on the influence of demographic variables such as gender, subject stream, and locality. The purpose of the research is to assess the level of metacognitive awareness among students and examine whether it varies significantly across these demographic categories. A sample of 111 postgraduate students was selected from West Bengal State University (WBSU), West Bengal, India. The study employed descriptive statistics (mean and SD), independent sample *t*-tests, and Pearson correlation coefficient to test the hypotheses and examine relationships between variables. The results revealed no significant differences in metacognitive scores based on gender, subject stream (arts and science), or locality (rural and urban). While some comparisons showed statistically significant differences ($p < 0.05$), others were marginally non-significant or clearly not significant. Additionally, the study found a weak positive correlation between metacognition and academic achievement; however, this relationship was not statistically significant. These findings suggest a potential trend but do not support a strong predictive relationship. The study highlights the complexity of metacognitive processes and emphasizes the need for further research with larger, more diverse samples to better understand its role in academic performance.

Keywords:
Metacognition, Predictive Value, Postgraduate Students, Academic Outcome

Article History:
Received: 30 September 2025
Revised on: 2 December 2025
Accepted: 11 December 2025

Correspondence to:
Azharuddin Molla
azharuddinmolla711@gmail.com

ISSN: 2331-315X

Introduction

Metacognition plays a significant role in education (Paris & Winograd, 1990) because metacognition enables learners to design their own learning strategies, track their progress, and assess the effectiveness of those strategies. In this way, it encourages learners to actively participate and take greater responsibility in the learning process (Ismayati et al., 2020; Papaleontiou–Louca, 2003). Most studies show that effective learners have different metacognition compared to less effective learners. Those who use metacognition well are more strategic, more likely to use problem-solving methods, and better at predicting their test scores (Djudin, 2018; Stanton et al., 2021). In recent years, the role of cognitive and metacognitive procedures in academic learning has gained significant attention in educational research. Metacognition, often defined as "thinking about one's own thinking," (Maryani et al., 2020; Wang, 2020) it refers to the awareness and regulation of one's cognitive procedures in the process of learning. It is made up of two main components — metacognitive knowledge (understanding about one's own learning processes) and metacognitive regulation (the capacity to design, monitor, and assess learning strategies (Merkebu et al., 2024; Wodaj, 2020)). These abilities are essential for learners to become self-directed, reflective, and adaptive in their academic pursuits. Metacognitive awareness involves understanding what to believe and how to know, which are important goals for development and education (Şendağ & Odabaşı, 2009).

Within the higher education institute's learning environment, where students are expected to engage with complex concepts, manage independent study schedules, and perform under evaluative conditions, the importance of metacognitive skills becomes even more pronounced (Djudin, 2018; Taylor, 1983). Several studies have indicated that students with higher metacognitive awareness are likely to achieve higher academic outcome (Daniar et al., 2023), as they can effectively plan, monitor, and adjust their learning strategies based on task demands and feedback.

Even though many studies have been done in this area, more research is still needed to explore it further, how metacognitive awareness and regulation specifically influence academic achievement among postgraduate students across diverse educational contexts. This study aims to examine the effect of metacognition on the academic performance of postgraduate learners, investigating how students' ability to understand and control their cognitive strategies impacts their academic outcomes. The findings of this research are expected to provide valuable insights for educators and curriculum designers, encouraging the integration of metacognitive training within undergraduate programs to enhance academic success and lifelong learning skills.

Review of Related Literature

Previous research shows that metacognition is very important for students because it helps them plan their work, check their progress, and evaluate how well they are

learning. Students who use metacognitive skills regularly become more active and responsible in the learning process (Steven, 2008; Minikutty & Abbas, 2011). Many studies have found clear differences between effective and ineffective learners. Effective learners usually use more strategies, think more carefully, use problem-solving steps, and can judge their performance more accurately (Pintrich & DeGroot, 1990). Research also shows a strong connection between metacognition and academic achievement (Reddy and Shantakumari, 2004; Coutinho, 2007). Students who perform well in their studies generally have higher metacognitive awareness. Because of this, many researchers consider metacognition a strong predictor of academic success (Dunning et al., 2003; Sperling et.al, 2004; Kocak & Bayaci, 2011). Learners with better metacognitive skills often achieve higher marks and understand their lessons more deeply compared to those with low metacognition. Another group of studies shows that training programs on metacognitive strategies can help students improve their learning skills (Rezvan et al., 2006). Students who start with weak metacognitive abilities can make good progress when they receive proper guidance and practice. However, some studies have reported mixed or negative results. A few researchers found little or no difference in students' achievement after applying metacognitive strategies. These differences in findings suggest that metacognition does not work the same way for all learners or in all situations (Cubukcu, 2009). Therefore, more research is needed to understand how metacognition supports learning under different conditions and for different groups of students.

Research Gap

Although metacognition is widely recognized as one of the most important psychological factors influencing academic achievement, existing research has primarily examined it in combination with several other variables, making it difficult to isolate its unique contribution. Most studies have been conducted on school and college student groups, while very few have focused on postgraduate groups. Demographic dimensions such as gender, locality, and subject stream have not been explored in a comprehensive and comparative manner as well. In particular, only a limited number of studies have been conducted within specific localities, resulting in a lack of context-specific insights about how metacognitive processes vary across diverse geographical and socio-academic environments. Therefore, a focused investigation examining the independent role of metacognition on academic achievement across demographic categories—especially within a defined locality—remains an important gap that the present study seeks to address.

Origin and Meaning of Metacognition

The term “Metacognition” has its roots in the discipline of psychology. It is derived from two parts: the Greek prefix “meta-”, which means *beyond* or *about*, and the word “cognition”, which refers to *thinking* or *knowing*. When combined, the term literally

translates to “thinking about thinking.” This simple yet powerful phrase captures the essence of metacognition, which focuses on individuals’ awareness and regulation of their own cognitive processes (Pp, 2008).

The concept of metacognition was first introduced by John H. Flavell in 1976, a noted American developmental psychologist. Flavell coined the term during his research on children’s cognitive development, specifically their awareness of their own memory processes and the strategies they used to learn and remember information (Engen, 2018; Lai, 2011). His studies demonstrated that children could develop an understanding of how their minds work and could use that understanding to improve their learning.

Flavell defined metacognition as “one’s knowledge concerning one’s own cognitive processes, or anything related to them.” In other words, it refers to an individual’s ability to reflect on, monitor, and control their thought processes. This marked a significant development in educational psychology, as it highlighted how learners could actively engage in planning, monitoring, and assessing their thinking and learning strategies (Cattáneo & Motta, 2020). Subsequent research has broadened this definition to encompass both the awareness of one's mental states and the regulation of behaviours and emotions associated with learning (Kawata et al., 2021).

John H. Flavell, an American developmental psychologist, first began to study and theorize about metacognition in the late 1970s. Flavell was a student of Jean Piaget, the renowned psychologist who developed the Theory of Cognitive Development. Inspired by Piaget’s work on how children think and learn, Flavell extended the ideas further and introduced the concept of metacognition to describe how individuals can become aware of and regulate their own thinking processes (Alonso et al., 2010).

Flavell proposed that metacognition consists of **two major components**:

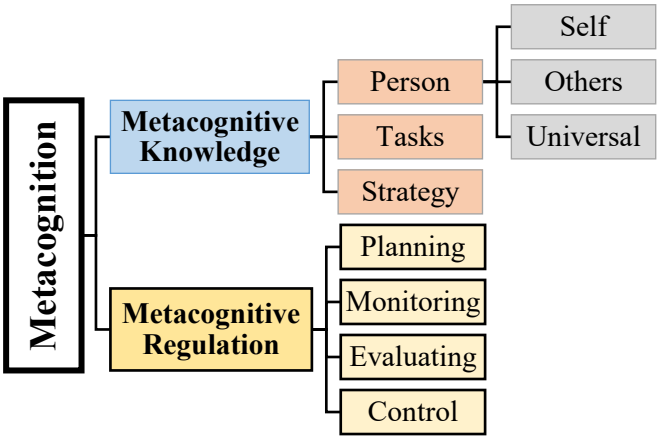

Figure 1. Components of Metacognition (Chu, Arumugam, & Huang, 2024)

- **Metacognitive Knowledge** – This refers to the awareness and understanding of one's own cognitive processes. It includes knowing about strategies for learning, understanding the tasks at hand, and recognizing one's strengths and weaknesses in learning (Jaleel & Premachandran, 2016; Lan & Huy, 2021).
- **Metacognitive Regulation** – This involves the actual control of cognitive activities in the process of learning. It includes planning how to start and carry out a task, monitoring progress during the process, and evaluating the outcomes after completion (Stebner et al., 2022).

By understanding and applying these two aspects, learners can actively train their minds to develop effective strategies for learning. This self-awareness and regulation not only improve academic performance but also help individuals discover the best methods that work for them in different learning situations.

Importance of Metacognition among Postgraduate Students

Research has consistently shown that incorporating metacognitive strategies within postgraduate curricula significantly enhances students' ability to plan, monitor, and evaluate their learning processes (Rahman et al., 2014). Students who actively engage in metacognitive regulation tend to demonstrate higher problem-solving proficiency and superior academic outcomes (Şendağ & Odabaşı, 2009; Hamzah et al., 2023). This regulation is underpinned by metacognitive knowledge and strategies—such as planning, self-checking, and awareness that foster adaptive learning behaviours in advanced study contexts (Chen et al., 2025). Empirical studies have further demonstrated that targeted metacognitive interventions enable postgraduate learners to more effectively identify research problems and construct robust problem statements, thereby strengthening their overall research competence (Rahman et al., 2014). In addition, integrating reflective analytics on learners' code artifacts—through static and dynamic analyses—has been shown to amplify metacognitive awareness in computational thinking contexts. Embedding second-order computational reflection tools within curricula provides learners with concrete diagnostic feedback that cultivates deeper metacognitive insight (Kong & Abelson, 2019).

Curricula that embed structured reflective prompts and diagnostic analytics are therefore likely to produce graduates who demonstrate superior self-regulation and research efficacy (Hidayat et al., 2023; Campos et al., 2018). Empirical evidence also suggests that systematic instruction of metacognitive techniques yields measurable gains in academic performance and critical thinking among higher education learners (Pereles et al., 2024; Kane et al., 2014). Additionally, professional development programs designed to train educators in fostering metacognition enhance instructors' awareness of student learning needs, thereby amplifying the impact of metacognitive curricula (Wass et al., 2023).

Importantly, evidence shows that postgraduate students often overestimate their non-technical competencies, which may undermine their actual performance. This highlights the need for calibrated self-assessment mechanisms (Montaño et al., 2022). To address this challenge, automated dashboards that visualize coding metrics and runtime behaviors have been proposed as effective scaffolds for learners' self-monitoring and deeper metacognitive engagement (Kong & Abelson, 2019). Such dashboards serve to tighten the loop between diagnostic feedback and metacognitive regulation, thereby promoting more sustained self-directed learning. Finally, leveraging analytics dashboards that integrate static code metrics with dynamic execution traces has been identified as an effective mechanism for operationalizing metacognitive scaffolds in postgraduate programming curricula (Pereles et al., 2024). Further empirical investigation is warranted to determine how adaptive, real-time feedback derived from such dashboards influences learners' self-efficacy and the durability of their programming expertise (Prather et al., 2024). Future work should experimentally evaluate these dashboards in postgraduate contexts, building on prior evidence that diagnostic visualizations improve instructional outcomes in introductory programming courses (Kong & Abelson, 2019; Li, 2024).

Research Objectives

i. Assess the level of metacognition among postgraduate students.

ii. Investigate potential differences in metacognition based on:

   a. Gender (male and female)

   b. Subject stream (arts and science)

   c. Locality (rural and urban)

iii. Examine the correlation among metacognition and academic achievement in postgraduate students.

Null Hypotheses

Ho1. There is no significant difference in metacognition levels among male and female of postgraduate students.
Ho2. There is no significant difference in metacognition levels among postgraduate students of arts and science streams.
Ho3. There is no significant difference in metacognition levels among postgraduate students from rural and urban localities.
Ho4. There is no significant correlation among metacognition levels and academic achievement of postgraduate students.

Methodology of the Study

This study employed a quantitative survey approach to investigate metacognition levels among postgraduate students. A total of 111 participants, all postgraduate students, were randomly selected from the district of North 24 Parganas, West Bengal. Data collection was conducted using a Google Form questionnaire. The standardized Metacognition Scale developed by Dr. Punita Govil was utilized to assess metacognition levels. This scale consists of 30 items and has demonstrated satisfactory psychometric properties, with a Cronbach's alpha reliability of 0.85 and adequate content validity. Data analysis was performed using IBM SPSS Statistics version 22. Descriptive statistics, including measures of mean and SD, were calculated to summarize the metacognition scores. Inferential statistical analyses were conducted to assess relationships among variables and test hypotheses, though specific tests are not mentioned in the provided information. The study adhered to proper guidelines for research involving human subjects, ensuring participant confidentiality and voluntary participation.

Delimitations of the Study

This study was carried out only with students from selected universities in one district of West Bengal. The researcher included only a fixed number of institutions, so the sample was limited to the institutions that could be reached through the chosen sampling method. The study focused only on Postgraduate students and did not include learners from any other educational levels. The research variables were limited to metacognitive awareness and a few demographic factors such as gender, locality, and subject stream. Data were collected through self-report questionnaires, so only those students who were available and agreed to respond within the given time were included. The study also did not observe how metacognition changes over time, because the data were collected only once and not in multiple phases.

Analysis and Interpretation of Data

Distribution of samples according to various background variables such as - Gender, Locality and Stream of students.

Variables	***Categories***	***Total Number***	***Percentage (%)***
Gender	Male	20	18.02 %
	Female	91	81.98 %
Locality	Rural	69	62.16 %
	Urban	42	37.83 %
Subject Stream	Arts	73	65.76 %
	Science	38	34.23 %

Table 1. Present the Demographic Characteristics of Sample

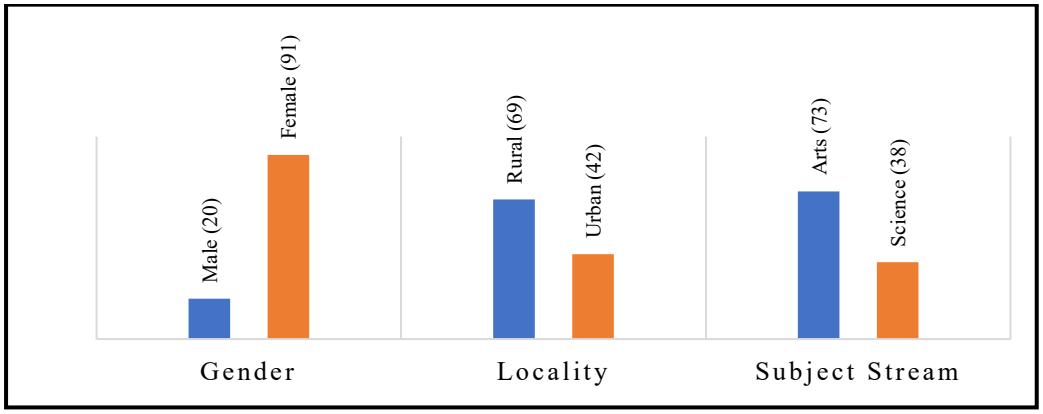

Figure 2. Distribution of Samples According to Various Demographic Background

1. Assess the level of metacognition among postgraduate students.

	N	Minimum	Maximum	Mean	Std. Deviation
Metacognition	111	30	118	87.43	15.765

Table 2. Level of Metacognition of Postgraduate Student's

SL. No.	*Range of Raw Score*	*Level of Metacognition*	*Frequency*
1	98 and above	Extremely High	3
2	90 to 97	High	4
3	82 to 89	Above Average	6
4	70 to 81	Average/Moderate	22
5	62 to 69	Below Average	20
6	54 to 61	Low	26
7	53 and below	Extremely Low	30

Table 3. Levels of Metacognition Score

Ho1. There is no significant difference in metacognition levels among male and female postgraduate students.

Variable	*Gender*	*N*	*Mean*	*Std. Deviation*	*Std. Error of Mean*
Metacognition	Male	20	83.10	18.330	4.099
	Female	91	88.38	15.091	1.582

Table 4. Descriptive Statistics of Metacognition Level by Gender

The data presents Metacognition scores for male and female participants. The sample consists of 20 males and 91 females. Males have a mean score of 83.10 with SD of 18.330, while females have a mean score of 88.38 with SD of 15.091. The higher mean score for females suggests they may have slightly better metacognitive skills. However, the larger standard deviation for males indicates more variability in their scores.

Variable	*t-test for Equality of Means*				
Metacognition	t	df	Sig. (2- tailed) P	Mean difference	Std. Error Difference
	-1.363	109	.053	-5.285	3.878

Table 5. Independent sample T-Test based on Ho1

The p-value (0.053) is slightly above the conventional significance level of 0.05, indicating the difference in Metacognition scores between groups is marginally non-significant. The negative t-value and mean difference suggest the comparison group has a higher average score, but this difference is not statistically significant at the 0.05 level. The results imply a trend towards a difference, but more evidence would be needed to conclude a significant disparity in Metacognition scores among the groups.

Ho2. There is no significant difference in metacognition levels among postgraduate students in arts and science streams.

Variable	*Locality*	*N*	*Mean*	*Std. Deviation*	*Std. Error of Mean*
Metacognition	Rural	69	89.75	13.176	1.586
	Urban	42	83.62	18.839	2.907

Table 6. Descriptive Statistics of Metacognition Level by Locality

The data reveals a comparison of Metacognition scores between rural and urban localities, with rural participants (N=69) showing a higher mean score (89.75) compared to urban participants (83.62, N=42). The urban group exhibits greater variability in scores, as indicated by a larger standard deviation (18.839) compared to the rural group (13.176). The mean difference of 6.13 points suggests that rural participants tend to

score higher on Metacognition. The rural group's standard error of the mean (1.586) is lower than the urban group's (2.907), indicating a more precise estimation of the population mean for the rural sample, partly due to its larger sample size. While these findings suggest a potential difference in Metacognition scores between rural and urban localities, with rural participants showing higher scores on average, statistical significance testing would be necessary to determine if this difference is meaningful.

Variable	***t-test for Equality of Means***				
Metacognition	t	df	Sig. (2-tailed) P	Mean difference	Std. Error Difference
	2.016	109	.046	6.135	3.043

Table 7. Independent sample T-Test based on Ho2

The analysis of Metacognition scores revealed a statistically significant difference between the two groups ($t(109) = 2.016$, $p = 0.046$). One group exhibited higher Metacognition scores, with a mean difference of 6.135 points (SE = 3.043). The t-statistic (2.016) indicates a moderate effect, and the large sample size (df = 109) enhances the reliability of the results. The p-value (0.046) is below the conventional 0.05 threshold, suggesting that the observed difference is likely not due to random chance.

Ho3. There is no significant difference in metacognition levels among postgraduate students from rural and urban localities.

Variable	***Subject Stream***	***N***	***Mean***	***Std. Deviation***	***Std. Error of Mean***
Metacognition	Arts	73	87.96	16.954	1.984
	Science	38	86.42	13.341	2.164

Table 8. Descriptive Statistics of Metacognition Level by Stream

The data compares Metacognition scores between ARTS (73 participants) and SCIENCE (38 participants) streams. ARTS students show a slightly higher mean score (87.96) compared to SCIENCE students (86.42), but with greater variability (standard deviation: 16.954 vs 13.341). The ARTS stream's larger sample size and lower standard error of mean (1.984 vs 2.164) suggest potentially more representative results. While these findings indicate broadly similar Metacognition levels between streams, further statistical analysis would be required to determine if the difference is significant.

Variable	*t-test for Equality of Means*				
Metacognition	t	df	Sig. (2-tailed) P	Mean difference	Std. Error Difference
	.486	109	.628	1.538	3.165

Table 9. Independent sample T-Test based on Ho3

The p-value (Sig. 2-tailed) of 0.628 is much larger than the conventional significance level of 0.05. This reflect that the difference in Metacognition scores between ARTS and SCIENCE streams is not statistically significant.

Ho4. There is no significant correlation among metacognition levels and academic achievement in postgraduate students.

Variables	*N*	*r*	*Significance*
Metacognition and Academic Achievement	111	.143	.135

Table 10. Correlation based on Ho4

The correlation of 0.143 indicates a weak positive relationship between Metacognition and Academic Achievement. The positive sign suggests that as Metacognition increases, Academic Achievement tends to increase slightly, and vice versa. With a p-value of 0.135, which is greater than the conventional threshold of 0.05, this correlation is not statistically significant. This means we cannot confidently rule out the possibility that the observed relationship is due to chance.

Main findings and Discussion

In the present study indicate that postgraduate students, on average, demonstrated an above-average level of metacognition (M = 87.43, SD = 15.765), although considerable individual differences were evident due to moderate–high variability in scores. Analysis of demographic variables revealed no significant gender differences (p = 0.053), despite female students scoring slightly higher than males and showing less variability. Similarly, differences across subject streams (Arts vs. Science) were negligible and statistically non-significant (p = 0.628), though Arts students showed marginally higher mean scores. Locality-based differences were more pronounced, as rural students reported significantly higher metacognition scores (M = 89.75) compared to urban students (M = 83.62; p = 0.046). This suggests that contextual and socio-cultural factors may influence metacognitive awareness. Finally, the relationship among metacognition and academic achievement was found to be positive but weak (r = 0.143, p = 0.135), indicating no

statistically significant predictive value. Thus, while metacognition appears to be present at above-average levels among postgraduate learners, its impact on academic performance is not straightforward and may be moderated by other factors.

The present study suggests that postgraduate students, on average, demonstrate above-average levels of metacognitive awareness, which indicates that higher education environments may foster reflective and self-regulated learning practices. Gender differences were not statistically significant, though females showed slightly higher mean scores and males displayed greater variability, supporting earlier research that reported minimal or inconsistent gender effects on metacognition. Locality differences, however, were significant, with rural students outperforming their urban counterparts, a finding that challenges the assumption of urban advantage and points to the possibility that rural learners develop stronger self-regulation strategies to adapt to contextual challenges. Subject stream differences between Arts and Science were negligible, reinforcing the idea that metacognition is a domain-general skill rather than discipline-specific. The relationship among metacognition and academic achievement, though weakly positive, was not statistically significant, suggesting that academic success is shaped by multiple factors beyond metacognitive awareness alone. Collectively, these results highlight the complex and context-dependent nature of metacognition and emphasize the need to integrate metacognitive training within postgraduate curricula while encouraging further research to examine socio-cultural and institutional influences on its development.

Limitations of the Study

The present study has certain limitations, which should be kept in mind while interpreting the findings:

- The study was conducted only in selected university of one district in West Bengal, which limits the generalizability of the results to other regions or larger populations.
- The research included only postgraduate students, which means the findings may not apply to students from other educational levels.
- The data were collected at a single point in time, limiting the ability to understand changes in metacognitive awareness over longer periods.
- Only a few variables such as gender, locality, and subject stream were included, while other important factors like socio-economic background or learning environment were not considered.
- The study examined only metacognitive awareness and did not explore related constructs such as motivation, study habits, or instructional practices that might also influence learning outcomes.

Educational Implications

- Metacognitive activities that encourage students to reflect on what they know, what they value, and what they can do help them develop greater self-awareness. These reflective tasks also provide teachers with important insights that can guide and improve instructional practices.
- Students in any classroom differ in their levels of metacognitive awareness, teachers should recognize these individual differences and adjust their teaching methods accordingly. By providing appropriate and effective instruction, teachers can significantly enhance students' metacognitive abilities.
- The study indicates that factors such as gender, locality, and subject stream do not have any significant influence on students' metacognitive ability. Therefore, the real need is to adopt innovative teaching methods and engaging learning activities that stimulate and foster students' metacognitive development.
- Developing metacognitive ability from the school to university level is essential. When students learn to reflect on their learning strategies and classroom performance, they can identify their strengths and weaknesses and improve their academic achievement more effectively.

Conclusion

The present study explored the predictive value of metacognition in relation to academic achievement among postgraduate students, with consideration of demographic variables such as gender, subject stream, and locality. The findings revealed that, while students generally demonstrated above-average levels of metacognitive awareness, significant variations were limited to locality, with rural students scoring higher than urban counterparts. No meaningful differences were observed across gender or subject streams, and the relationship among metacognition and academic achievement, though positive, was weak and not statistically significant. These results suggest that metacognition, while an important component of the learning process, does not independently determine academic success and should be considered alongside other cognitive, motivational, and contextual factors. The study underscores the value of fostering metacognitive strategies within postgraduate education to support self-regulated learning and critical thinking, while also highlighting the need for further research that examines socio-cultural influences and employs larger, more diverse samples to better understand the role of metacognition in academic contexts.

References

1. Alonso, M., Auxepaules, L., & Py, D. “DIAGRAM, un EIAH pour l’initiation à la modélisation orientée objet avec les diagrammes de classe UML”. *HAL (Le Centre Pour La Communication Scientifique Directe)*, vol. 17, 2010, pp. 1-22, https://hal.science/hal-00696313
2. Campos, F., Sola, M., Santisteban-Espejo, A., Ruyffelaert, A., Campos-Sánchez, A., Garzón, I., Carriel, V., Luna, J. de D., Martín-Piedra, M. Á., & Alaminos, M. “Conceptions of learning factors in postgraduate health sciences master students: a comparative study with non-health science students and between genders”. *BMC Medical Education,* vol. 18, no.1, 2018 https://doi.org/10.1186/s12909-018-1227-x
3. Cattáneo, A., & Motta, E. “I Reflect, Therefore I Am… a Good Professional”: On the relationship between reflection-on-action, reflection-in-action and professional performance in vocational education.” *Vocations and Learning,* vol. 14, 2020, pp.185-204, https://doi.org/10.1007/s12186-020-09259-9
4. Chen, X., Li, X., Zou, D., Xie, H., & Wang, F. L. “Metacognition research in education: Topic modeling and bibliometrics.” *Educational Technology Research and Development.,* vol. 73*,* 2025, pp.1399-1427*,* https://doi.org/10.1007/s11423-025-10451-8
5. Chu, L., Arumugam, N., & Huang, Z. (2024). Implementing the metacognitive pedagogical cycle: Effects on listening performance and learners’ perceptions. *International Journal of Religion,* vol. 5, no.11, 2024, pp.2474–2483. https://doi.org/10.61707/mqepva97
6. Coutinho, S. (2007). “The Relationship between goals, Metacognition, and Academic success”, *Educate Journal*, vol. 7, no.1, 2007, pp. 39- 47.
7. Cubukcu, F. “Metacognition in the classroom”, *Procedia social and behavioural science*, vol. 1, no.1, 2009, pp. 559-563.
8. Daniar, A. V., Herdyastuti, N., & Lutfi, A. “Analysis effectiveness of implementation assessment as learning on metacognitive skills." *IJORER International Journal of Recent Educational Research,* vol. 4, no.6, 2023, pp. 759-770. https://doi.org/10.46245/ijorer.v4i6.392
9. Djudin, T. “Preparing a strategic learner by using metacognitive strategies: From theory into practice*”, Journal of Education and Learning,* vol.12, no.3, 2018, pp.501-509 https://doi.org/10.11591/edulearn.v12i3.7209
10. Dunning, D., Johnson, K., Ehrlinger, J. and kruger, J. “Why people fail to recognize their own incompetence.” current *Directions in psychological science*, vol. 12, no.2, 2003, pp. 33-87.
11. Engen, T. O. “How metacognition and (reading) strategies develop according to Vygotsky.” *Problemy Wczesnej Edukacji,* vol. 42, no.3, 2018, pp. 27-36. https://doi.org/10.26881/pwe.2018.42.04
12. Guerra, A., Spliid, C. C. M., & Kolmos, A. (2018). Aalborg UNESCO Centre Certificate: A new approach to staff training and curriculum innovation. In WANG. Sunyu, A. KOLMOS, A. GUERRA, & QIAO. Weifeng (Eds.), 7th International

Research Symposium on PBL: Innovation, PBL and Competences in Engineering Education (pp. 573-585). Aalborg Universitetsforlag. https://local.forskningsportal.dk/local/dki-cgi/ws/cris-link?src=aau&id=aau-513e244f-0b3f-4fc4-ba79-8ca8ee652f4c&ti=Aalborg%20UNESCO%20Centre%20Certificate

13. Hamzah, H., Hamzah, M. I., & Zulkifli, H. "Self-regulated learning theory in metacognitive-based teaching and learning of high-order thinking skills (HOTS)." *TEM Journal,* vol. 12, no.4, 2023, pp. 2530 - 2540. https://doi.org/10.18421/tem124-65
14. Hidayat, R., Hermandra, & Ying, S. T. D. "The sub-dimensions of metacognition and their influence on modeling competency." *Humanities and Social Sciences Communications,* vol. 10, no.1, 2023,pp. 1-12, https://doi.org/10.1057/s41599-023-02290-w
15. Hu, Z., Zheng, B., & Wang, X. "The impact of a metacognitive self-regulation inventory in translator self-training: A pre-post study with English-Chinese translation students." *The Interpreter and Translator Trainer,* vol. 15, no.4, 2020, pp. 430-449. https://doi.org/10.1080/1750399x.2020.1844436
16. Ismayati, I., Ratnaningsih, N., & Supratman, S. "Students' metacognition and self-regulated learning: An analysis through students' work in solving HOTS problem" *JETL (Journal of Education Teaching and Learning),* vol. 5, no.1, 2020, pp. 21-27. https://doi.org/10.26737/jetl.v5i1.1328
17. Jaleel, S., & Premachandran, P. "A study on the metacognitive awareness of secondary school students." *Universal Journal of Educational Research,* vol. 4, no.1, 2016, pp. 165-172. https://doi.org/10.13189/ujer.2016.040121
18. Kane, S., Lear, M., & Dube, C. "Reflections on the role of metacognition in student reading and learning at higher education level." *Africa Education Review,* vol. 11, no.4, 2014 pp. 512-525. https://doi.org/10.1080/18146627.2014.935001
19. Kawata, K. H. dos S., Ueno, Y., Hashimoto, R., Yoshino, S., Ohta, K., Nishida, A., Ando, S., Nakatani, H., Kasai, K., & Koike, S. "Development of metacognition in adolescence: The congruency-based metacognition scale". *Frontiers in Psychology,* vol. 11, pp.1-10. https://doi.org/10.3389/fpsyg.2020.565231
20. Kocak, R. Bayaci, M. "The predictive role of basic ability levels and metacognitive strategies of students on their academic success," *Procedia social and behavioral sciences*, vol. 2, no.2, 2010, pp. 767-772.
21. Kong, S. C., & Abelson, H. *Computational thinking education.* Springer Nature, 2019. https://doi.org/10.1007/978-981-13-6528-7
22. Lai, E. *Metacognition: A literature review.* Pearson Assessments, 2011. http://images.pearsonassessments.com/images/tmrs/metacognition_literature_review_final.pdf
23. Lan, N. T. H., & Huy, D. T. N. (2021). "Developing students' mathematical competence through equipping them with necessary knowledge about metacognition and activities in teaching mathematics in secondary school."

LAPLAGE EM REVISTA, vol. 7, no. 3B, pp. 24-35. https://doi.org/10.24115/s2446-6220202173b1481p.24-35

24. Li, W. *Understanding learners and the interplay between metacognitive judgements of learning and AI-generated explanations*. Deep Blue (University of Michigan), 2024, https://doi.org/10.7302/23945
25. MacNeil, S. L., Wood, E., & Arslantas, F. Development of a metacognition co-curriculum for a university course in introductory organic chemistry. *Frontiers in Education, vol. 9, 2024, pp.1-8.* https://doi.org/10.3389/feduc.2024.1402599
26. Maryani, I., Putri, D. R., Urbayatun, S., Suyatno, S., & Bhakti, C. P. "Metacognition and integrated-project based learning (I-PjBL) in elementary schools." *Universal Journal of Educational Research,* vol. 8, no.3, 2020, pp. 1046-1054. https://doi.org/10.13189/ujer.2020.080339
27. Merkebu, J., Veen, M., Hosseini, S., & Varpio, L. "The case for metacognitive reflection: A theory integrative review with implications for medical education." *Advances in Health Sciences Education,* vol. 29, no.4, 2024, pp. 1481-1500. https://doi.org/10.1007/s10459-023-10310-2
28. Minikutty, A. & Alka Abbas, M.A. "Metacognition among secondary school students endeavour in education", *The Journal of Educational Research*, vol. 115, no.1, 2011 pp. 45-49.
29. Montaño, J. L. A., Fernández-Polvillo, C., & Hassall, T. "Non-technical skills and students' overconfidence in accounting." *Education + Training,* vol. 64, no.5, 2022, pp. 716-733. https://doi.org/10.1108/et-08-2021-0309
30. Negi, S. K., Rajkumari, Y., & Rana, M. "A deep dive into metacognition: Insightful tool for moral reasoning and emotional maturity." *Neuroscience Informatics,* vol. 2, no.4, 2022. https://doi.org/10.1016/j.neuri.2022.100096
31. Papaleontiou–Louca, E. "The concept and instruction of metacognition". *Teacher Development,* vol. 7, no.1, 2003, pp. 9-30. https://doi.org/10.1080/13664530300200184
32. Paris, S. G., & Winograd, P. " Promoting metacognition and motivation of exceptional children". *Remedial and Special Education,* vol. 11, no.6, 1990. https://doi.org/10.1177/074193259001100604
33. Pereles, A., Ortega-Ruipérez, B., & Alcalde, M. L. " The power of metacognitive strategies to enhance critical thinking in online learning". *Journal of Technology and Science Education,* vol. 14, no.3, 2024, pp. 831-843. https://doi.org/10.3926/jotse.2721
34. Pintrich, P.R., &De Groot, E.V. "Motivation and self-regulated learning components of classroom academic performance", *journal of educational psychology*, vol. 82, 1990, pp. 33-40.
35. Pp, N. "Cognitions about cognitions: The theory of metacognition" *ERIC Institute of Education Sciences.,* 2008, http://files.eric.ed.gov/fulltext/ED502151.pdf
36. Prather, J., Reeves, B. N., Leinonen, J., MacNeil, S., Randrianasolo, A. S., Becker, B. A., Kimmel, B., Wright, J., & Briggs, B. "The widening gap: The

benefits and harms of generative AI for novice programmers." *ICER (Cornell University),* 2024, https://doi.org/10.48550/arxiv.2405.17739
37. Rahimi, M., & Katal, M. " Metacognitive strategies awareness and success in learning English as a foreign language: An overview." *Procedia – Social and Behavioral Sciences,* vol. 31, 2012, pp. 73-81. https://doi.org/10.1016/j.sbspro.2011.12.019
38. Rahman, S., Yasin, R. M., Salamuddin, N., & Surat, S. "The use of metacognitive strategies to develop research skills among postgraduate students" *Asian Social Science,* vol. 10, no.19, pp. 271-275, 2014, https://doi.org/10.5539/ass.v10n19p271
39. Rahayu, S., Handayanto, S. K., Zulaikah, S., & Ahda, S. "Students' regulation of cognition in physics problem-solving." *Journal of Physics Conference Series,* vol. 1097, 2018, pp. 1-8. https://doi.org/10.1088/1742-6596/1097/1/012029
40. Reddy, Y. L & Shantakumari. "English language learning difficulties: metacognitive awareness of students", *Educational Research,* vol. 40, no.2, 2004, pp. 237-243.
41. Rezvan, S., Ahmadh, S., and Abedi, M. "The effect of metacognition training on the academic achievement and happiness of Esfahan University conditional students." *Counseling Psychology Quarterly*, vol. 19, no.4, 2006, pp. 415- 428.
42. Sendag, S., & Odabaşı, H. F. "Effects of an online problem-based learning course on content knowledge acquisition and critical thinking skills." *Computers & Education,* vol. 53, no.1, 2009, pp. 132-141. https://doi.org/10.1016/j.compedu.2009.01.008
43. Sperling, R. A., Howard, B. C., Staley, R., & DuBois, N. "Metacognition and Self-Regulated Learning Constructs". *Educational Research and Evaluation*, vol.10, 2010, pp. 117-139, https://doi.org/10.1076/edre.10.2.117.27905
44. Stanton, J. D., Sebesta, A. J., & Dunlosky, J. " Fostering metacognition to support student learning and performance." *CBE—Life Sciences Education,* vol. 20, no.2, 2021, pp. 20:fe3, 1-7, https://doi.org/10.1187/cbe.20-12-0289
45. Stebner, F., Schuster, C., Weber-Reuter, X.-L., Greiff, S., Leutner, D., & Wirth, J. "Transfer of metacognitive skills in self-regulated learning: Effects on strategy application and content knowledge acquisition." *Metacognition and Learning,* vol. 17, no.3, 2022, pp. 715-744. https://doi.org/10.1007/s11409-022-09322-x
46. Steven, D " Using metacognitive strategies and learning styles to create self-directed learners." *Institute for Learning Style Journal*, vol. 1, 2008, pp. 14-28.
47. Taylor, N. E. "Metacognitive ability: A curriculum priority." *Reading Psychology,* vol. 4, no.3, 1983, pp. 269-278. https://doi.org/10.1080/0270271830040308
48. Wang, J. "Exploring the perceived integrations between assessment and metacognition: A qualitative inquiry of three award-winning teacher educators' conceptions of assessment in a Hong Kong University context". *Frontiers in Education,* vol. 4, 2020, pp.1-15, https://doi.org/10.3389/feduc.2019.00157
49. Wass, R., Rogers, T. L., Brown, K., Smith-Han, K., Tagg, J., Berg, D. A. G., & Gallagher, S. "Pedagogical training for developing students' metacognition:

Implications for educators". *The International Journal for Academic Development,* vol. 1, 2023, pp. 1-14 https://doi.org/10.1080/1360144x.2023.2246442

50. Wodaj, H. "Effects of 7E instructional model with metacognitive scaffolding on students' conceptual understanding in biology." *Journal of Education in Science Environment and Health,* vol. 7, no.1, 2020, pp. 26-43 https://doi.org/10.21891/jeseh.770794.