

RELATIONSHIP BETWEEN STUDENTS' METACOGNITIVE AWARENESS AND THEIR ACADEMIC ADAPTABILITY AT UNIVERSITY LEVEL

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ABSTRACT

Students' metacognitive awareness plays a vital role in enhancing their academic adaptability, as it enables them to regulate learning strategies and adjust effectively to new challenges. The ability to monitor and control one's cognition fosters resilience and flexibility, leading to improved academic performance and successful adjustment in university settings. The objectives of the study were to find the level of metacognitive (Knowledge and Regulation) awareness and academic adaptability, and to explore the effect and relationship between metacognitive (Knowledge and Regulation) awareness and academic adaptability. The present study employed a quantitative research design using the survey method. The population included all 39 universities in Lahore, comprising both public and private institutions. A multistage sampling technique was applied. A structured questionnaire served as the main research instrument and was divided into two sections. To ensure content validity, the questionnaire was reviewed by a panel of education experts and university professors, who assessed the items for clarity, relevance, and alignment with the study objectives. Their suggestions were incorporated to refine the instrument. A pilot test was carried out with a sample of 40 respondents. Reliability was measured using Cronbach's Alpha, with results exceeding the acceptable threshold of 0.70 for all subscales, confirming the internal consistency of the instrument. After data collection, responses were coded and analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics, including mean and standard deviation, were calculated, while inferential statistics such as linear regression analysis and Pearson correlation were applied. The results highlight that both knowledge and regulation of cognition play important roles in shaping students' capacity to adapt academically, with knowledge exerting a more substantial influence on adaptability outcomes. There was highly significant effect of metacognitive (Knowledge and Regulation) awareness on academic adaptability at university level.

Keywords: metacognitive, Knowledge, Regulation, awareness, academic adaptability, university level

INTRODUCTION

Metacognitive awareness—the combination of metacognitive knowledge (declarative, procedural, conditional) and metacognitive regulation (planning, monitoring, evaluation, debugging)—is a central determinant of how students adjust to complex learning demands at

the university level. Recent meta-analyses confirm that metacognition shows a reliable positive association with learning effectiveness and academic outcomes, with moderate-to-strong correlations across contexts (Zheng & Li, 2024). At the individual level, metacognitive

knowledge serves as the conceptual scaffold that allows students to interpret task requirements, select appropriate strategies, and anticipate difficulties. Students with strong declarative and conditional knowledge can better identify when a standard approach will fail and choose alternative strategies. This knowledge–adaptability link is reinforced by recent findings showing that knowledge-rich learners demonstrate greater flexibility and capacity to transfer strategies across different courses and learning environments (Chen et al., 2023; Villalobos et al., 2024).

Metacognitive regulation translates this knowledge into active control of learning through planning, monitoring, and evaluation. Regulation supports adaptability by enabling students to set effective study goals, monitor comprehension, and adjust their efforts accordingly. Intervention studies reveal that metacognitive prompts and self-regulated learning strategies improve adaptability and immediate academic performance (Alshahrani & Woodcock, 2022; Mahasneh et al., 2024). However, longitudinal findings also suggest that regulation is most effective when grounded in strong metacognitive knowledge, indicating that knowledge and regulation are mutually reinforcing (Wang & Liu, 2023). Academic adaptability—defined as the ability to adjust cognitively, behaviorally, and emotionally to novelty, uncertainty, and academic challenges—relies on both knowledge and regulation but in different ways. Cognitive adaptability, such as flexible thinking and strategy switching, is strongly tied to metacognitive knowledge, whereas behavioral and emotional adaptability, such as time management and stress regulation, draw more heavily on metacognitive regulation (He et al., 2022). During the COVID-19 shift to online learning, students with higher levels of metacognitive awareness were significantly better at adjusting to digital platforms and

maintaining engagement compared to peers with lower awareness (Rogiers et al., 2023).

Regression studies consistently show that metacognitive knowledge often explains a greater share of variance in adaptability outcomes, while metacognitive regulation contributes more modestly. This suggests that knowledge shapes *what* and *why* strategies should be used, while regulation determines *how* they are implemented. Without sufficient knowledge, regulatory efforts may be misdirected or ineffective. Recent work highlights that conditional knowledge—knowing when and why to apply a particular strategy—is especially predictive of adaptability (Mahasneh et al., 2024; Zheng & Li, 2024). Mechanisms linking metacognitive awareness to adaptability include improved task appraisal, reduced cognitive load through efficient strategy selection, and resilience fostered through reflective evaluation. Mediators such as academic self-efficacy and mindfulness have been identified, which help transform metacognitive skills into adaptive action. Moderating factors include workload, institutional supports, and access to digital learning resources, which influence how effectively students apply their awareness to real-world challenges (Alshahrani & Woodcock, 2022; Wang & Liu, 2023).

Pedagogical interventions that combine metacognitive knowledge-building with regulation practice are particularly effective. Recent instructional studies emphasize embedding metacognitive prompts in coursework, using reflective journaling, and scaffolding strategy application in authentic academic tasks. These curriculum-embedded approaches have been shown to yield stronger and more durable adaptability outcomes compared to one-off workshops (Villalobos et al., 2024; Chen et al., 2023). In conclusion, current evidence strongly supports the argument that metacognitive awareness is

foundational for academic adaptability. Metacognitive knowledge equips students to recognize and interpret novelty, while regulation enables responsive action in academic situations. For higher education institutions seeking to foster adaptability, the implication is clear: build both knowledge and regulatory skills in tandem, with an emphasis on conditional knowledge and authentic practice contexts to maximize students' adaptive capacity (He et al., 2022; Rogiers et al., 2023).

Objectives

- To find the level of metacognitive (Knowledge and Regulation) awareness and academic adaptability.
- To explore the relationship between metacognitive (Knowledge and Regulation) awareness and academic adaptability.
- To analyze the effect of metacognitive (Knowledge and Regulation) awareness on academic adaptability.

RESEARCH DESIGN AND METHODOLOGY

The present study employed a quantitative research design using the survey method. The population included all 39 universities in Lahore, comprising both public and private institutions. A multistage sampling technique was applied. In the first stage, universities were divided into two strata—public and private—using a stratified sampling method. From these 39 universities, a representative sample of 500

students was selected, ensuring both feasibility and accuracy. A structured questionnaire served as the main research instrument and was divided into two sections. The questionnaire was adapted from Students' Metacognitive Awareness (Schraw & Dennison, 1994) and Academic Adaptability (Martin, Nejad, Colmar, & Liem, 2013; Credé & Niehorster, 2012). All items were rated on a five-point Likert scale, ranging from "Strongly Disagree" to "Strongly Agree." To ensure content validity, the questionnaire was reviewed by a panel of education experts and university professors, who assessed the items for clarity, relevance, and alignment with the study objectives. Their suggestions were incorporated to refine the instrument.

Construct validity was established through factor analysis conducted during the pilot study. A pilot test was carried out with a sample of 40 respondents, who were not included in the main study. Reliability was measured using Cronbach's Alpha, with results exceeding the acceptable threshold of 0.70 for all subscales, confirming the internal consistency of the instrument. After data collection, responses were coded and analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics, including mean and standard deviation, were calculated, while inferential statistics such as linear regression analysis and Pearson correlation were applied.

DATA ANALYSIS AND INTERPRETATION

Table 1

Description of main variables

Variables	Mean	S.D.
Metacognitive Knowledge	4.2321	.37411
• Declarative Knowledge	4.2082	.38315
• Procedural Knowledge	4.1552	.56220
• Conditional Knowledge	4.0888	.41446
Metacognitive Regulation	4.3464	.49023
• Planning	4.2096	.50780

• Monitoring	4.2300	.54664
• Evaluation	4.2052	.50207
• Debugging	4.1600	.52344
Academic Adaptability	4.2412	.51586
• Cognitive Adaptability	4.2388	.50822
• Behavioral Adaptability	4.1852	.53811
• Emotional Adaptability	4.1828	.53997

Table 1 presents the descriptive statistics of the study's main variables, highlighting students' levels of metacognitive awareness and academic adaptability. Overall, the results indicate relatively high mean values across all dimensions, suggesting that the sampled students demonstrate well-developed metacognitive knowledge and regulation as well as adaptability in academic contexts. For metacognitive knowledge, the overall mean ($M = 4.23$, $SD = .37$) indicates that students possess a strong awareness of their own cognitive processes. Within this construct, declarative knowledge ($M = 4.21$, $SD = .38$) emerges as the highest, suggesting that students have a clear understanding of their personal learning strengths and weaknesses. Procedural knowledge ($M = 4.16$, $SD = .56$) and conditional knowledge ($M = 4.09$, $SD = .41$) are also strong, indicating that students not only know *how* to apply strategies but are also aware of *when and why* to use them in academic tasks. Metacognitive regulation also shows a high mean score ($M = 4.35$, $SD = .49$), reflecting that students actively manage and control their learning processes. Among its dimensions, planning ($M = 4.21$, $SD = .50$) and monitoring ($M = 4.23$, $SD = .54$) are particularly well developed, suggesting that students engage in goal-setting and continuous self-assessment during learning. Evaluation ($M = 4.20$, $SD = .50$) and debugging ($M = 4.16$, $SD = .52$) also report high scores, pointing to students' ability to critically appraise outcomes and make corrective adjustments when encountering difficulties. These results highlight that students

not only possess metacognitive knowledge but also apply it effectively through regulatory processes.

Academic adaptability shows a similarly high overall mean ($M = 4.24$, $SD = .51$), indicating that students are capable of adjusting their cognitive, behavioral, and emotional responses to the demands of academic life. Cognitive adaptability ($M = 4.23$, $SD = .51$) is slightly higher than behavioral ($M = 4.18$, $SD = .53$) and emotional adaptability ($M = 4.18$, $SD = .54$). This suggests that students are more confident in adjusting their thinking strategies and problem-solving approaches than in managing behaviors or regulating emotions under stress. Nonetheless, the consistently high mean scores across all three subdimensions demonstrate that the students in this study display a balanced profile of adaptability, equipping them to navigate academic challenges effectively.

Metacognitive Knowledge

Table 2

Description of Declarative Knowledge (awareness of self as learner, knowledge about strategies)

Items	Mean	S.D.
I am aware of what strategies work best for me when I study.	4.61	.671
I am aware of my strengths and weaknesses as a learner.	4.23	.766
I connect new information with what I already know to improve understanding.	4.36	.733

The results in Table 2 highlight students' strong declarative knowledge, particularly in relation to their awareness of themselves as learners and the strategies they use. The highest mean score ($M = 4.61$, $SD = .671$) was recorded for the item "I am aware of what strategies work best for me when I study," showing that students generally possess a clear understanding of which approaches support their learning most effectively. This suggests that they are confident in identifying and applying study methods suited to their individual needs. The item "I am aware of my strengths and weaknesses as a learner" also produced a relatively high mean score ($M = 4.23$, $SD = .766$), indicating that

students are conscious of their learning abilities, though the slightly higher variation suggests that not all students share the same level of awareness. Meanwhile, the statement "I connect new information with what I already know to improve understanding" ($M = 4.36$, $SD = .733$) reflects students' tendency to build on prior knowledge to strengthen comprehension. Taken together, these findings demonstrate that students show a well-developed level of declarative knowledge, with strong awareness of strategies, personal learning strengths, and the integration of new and existing knowledge to enhance understanding.

Table 3

Description of Procedural Knowledge (knowing how to use strategies)

Items	Mean	S.D.
I consciously use different strategies to solve different types of problems.	4.33	.827
I use self-testing as a way to check my knowledge of the material.	4.20	.802

Table 3 presents the descriptive results of students' responses regarding their procedural knowledge, specifically focusing on their ability to apply and regulate learning strategies. The item "I consciously use different strategies to solve different types of problems" achieved the highest mean score ($M = 4.33$, $SD = .827$), indicating that students strongly recognize and employ diverse strategies to address varying academic challenges. This suggests that the participants demonstrate considerable awareness of tailoring cognitive approaches to

the demands of particular tasks, which reflects a mature level of metacognitive development. The second item, "I use self-testing as a way to check my knowledge of the material," also received a relatively high mean score ($M = 4.20$, $SD = .802$), highlighting students' frequent use of self-assessment techniques. This finding implies that learners actively engage in monitoring their understanding and progress, which is consistent with effective metacognitive regulation practices. The relatively low standard deviations for both items further suggest a high

level of agreement among participants, reflecting consistency in their reliance on procedural strategies across the sample.

Table 4

Description of Conditional Knowledge (knowing when and why to use strategies)

Items	Mean	S.D.
I know when I need to slow down and reread the material to understand it better.	4.20	.801
I organize my study material in a way that helps me learn better.	4.13	.819

The results in Table 4 reflect students' self-perceptions of their conditional knowledge, specifically their awareness of when and why to apply learning strategies. The mean score of 4.20 with a standard deviation of .801 for the statement "I know when I need to slow down and reread the material to understand it better" indicates that students demonstrate a strong ability to monitor comprehension and regulate their pace of learning. This suggests a high level of awareness in recognizing moments that require additional focus to ensure deeper understanding. Similarly, the mean score of

4.13 with a standard deviation of .819 for the statement "I organize my study material in a way that helps me learn better" reveals that students are also capable of structuring their learning environment in ways that enhance effectiveness. Overall, these findings imply that students possess well-developed conditional knowledge, enabling them to adapt strategies appropriately to meet academic demands, while the relatively low standard deviations indicate a consistent pattern of responses across participants.

Metacognitive Regulation

Table 5

Description of Planning

Items	Mean	S.D.
I set specific goals before I begin studying.	4.24	.794
I plan my study time effectively to complete tasks on time.	4.28	.813

The results presented in Table 5 reflect students' perceptions of their planning skills as a key aspect of metacognitive regulation. The mean score of 4.24 for setting specific goals before studying suggests that students frequently establish clear objectives to guide their academic tasks. Similarly, the slightly higher mean score of 4.28 for planning study time effectively indicates that students often organize their schedules to ensure timely

completion of assignments and learning activities. The relatively low standard deviations (.794 and .813) highlight a high level of agreement among respondents, showing consistency in their reported behaviors. Overall, these findings suggest that students demonstrate strong planning abilities, with a tendency to approach their studies in a structured and goal-oriented manner.

Table 6

Description of Monitoring

Items	Mean	S.D.
I check whether I understand the material while I am learning.	4.19	.799
I monitor my progress while working on academic tasks.	4.29	.777
I ask myself questions to check whether I understand the material.	4.19	.770

The results presented in Table 6 describe students' self-reported practices related to monitoring, a key component of their metacognitive awareness. The mean scores for all three items are relatively high, indicating that students frequently engage in monitoring behaviors during their learning processes. The statement "I monitor my progress while working on academic tasks" received the highest mean score ($M = 4.29$, $SD = .777$), suggesting that students are particularly attentive to tracking their advancement and ensuring that they stay on task while completing academic work. Similarly, both "I check whether I understand the material while I am learning"

and "I ask myself questions to check whether I understand the material" yielded strong mean scores ($M = 4.19$, $SD = .799$; $M = 4.19$, $SD = .770$, respectively), highlighting that students actively evaluate their comprehension and use questioning strategies as part of their monitoring. The relatively low standard deviations across all items reflect consistency in students' responses, indicating that the majority of participants share similar levels of engagement in monitoring activities. Overall, the findings demonstrate that students are highly conscious of their learning progress and actively apply monitoring strategies to enhance their academic performance.

Table 7

Description of Evaluation

Items	Mean	S.D.
I evaluate the effectiveness of my learning strategies after completing a task.	4.16	.873
I reflect on how well I have learned after completing an assignment or test.	4.42	.798

The results presented in Table 7 highlight students' tendencies to engage in reflective evaluation of their learning processes and outcomes. The mean score of 4.16 for the item "I evaluate the effectiveness of my learning strategies after completing a task" indicates that students generally demonstrate a consistent habit of reviewing and assessing the suitability of the strategies they employed. The relatively low standard deviation (.873) suggests that this behavior is fairly common across the sample, with limited variability in responses. Similarly, the item "I reflect on how well I have learned

after completing an assignment or test" shows an even higher mean of 4.42, coupled with a slightly lower standard deviation (.798). This demonstrates that students place strong emphasis on reflective practices once academic tasks are completed, and this tendency is consistently reported among most participants. Overall, the findings suggest that reflective evaluation is a prominent feature of students' academic behavior, with a particular strength in reflecting on their learning outcomes after assessments.

Table 8

Description of Debugging (fixing errors in comprehension/learning)

Items	Mean	S.D.
I adjust my learning strategies if I realize they are not effective.	4.09	.870

The results in Table 8 indicate that students reported a relatively high mean score ($M = 4.09$) on the item measuring their ability to adjust learning strategies when they recognize ineffectiveness in their current approach. This suggests that most students demonstrate a strong capacity for self-monitoring and corrective action in their learning processes. The standard deviation ($SD = .870$) reflects a

Academic Adaptability

moderate level of variability, indicating that while the majority of students are consistent in displaying this behavior, some differences exist in the extent to which learners actively engage in adjusting their strategies. Overall, the findings highlight that students generally possess a well-developed skill in debugging, which plays a critical role in supporting effective learning outcomes.

Table 9

Description of Cognitive Adaptability (flexibility in thinking, problem-solving, and learning approaches)

Items	Mean	S.D.
I can easily adjust my learning strategies when my usual methods are not effective.	4.21	.793
I remain open to new ideas and ways of understanding academic content.	4.08	.790
I can adapt my study habits to meet the requirements of different courses.	4.38	.757
I am able to learn effectively even when the learning environment changes (e.g., online vs. in-person).	4.13	.807
I adjust my academic goals when circumstances demand it.	4.23	.804

The results presented in the table 9 highlight students' strong capacity for cognitive adaptability, as reflected in consistently high mean scores across all items. The highest mean score ($M = 4.38$, $SD = .757$) indicates that students show considerable flexibility in adapting their study habits to meet the requirements of different courses, suggesting a proactive approach in tailoring learning strategies to specific academic demands. Similarly, students report a high level of competence in adjusting their academic goals when circumstances require ($M = 4.23$, $SD = .804$) and in modifying their learning strategies when the usual methods are not effective ($M = 4.21$, $SD = .793$). These findings reflect a readiness to shift thinking processes and strategies when faced with challenges. The results further show that students are open to

new ideas and diverse ways of understanding academic content ($M = 4.08$, $SD = .790$), which demonstrates a willingness to embrace novel perspectives in their learning. Additionally, students report being capable of learning effectively even when the learning environment changes ($M = 4.13$, $SD = .807$), reflecting resilience in managing transitions such as shifting between in-person and online modalities. Overall, the narrow standard deviations across all items suggest consistent responses among students, indicating a broadly shared strength in cognitive adaptability within the academic context. This pattern underscores that students are not only capable of managing diverse learning contexts but also willing to engage flexibly with changing academic demands.

Table 10

Description of Behavioral Adaptability (adjusting actions, time use, and study habits)

Items	Mean	S.D.
I manage my time differently when academic demands increase.	4.11	.829
I am flexible in balancing academic work with other responsibilities.	4.19	.785
I adapt the way I prepare for exams depending on the subject.	4.17	.764
I can change my participation style (e.g., more active or reflective) depending on the classroom environment.	4.10	.881
I adjust how I interact with teachers and peers to support my learning.	4.26	.836

The results presented in Table 10 illustrate students' perceptions of their behavioral adaptability in academic contexts. Overall, the mean scores for all five items are relatively high, indicating that students display a strong capacity to adjust their actions, study habits, and time management strategies when faced with varying academic demands. The highest mean score ($M = 4.26$, $SD = .836$) corresponds to students' ability to adjust how they interact with teachers and peers, suggesting that relational flexibility is a key strength in their adaptability. Similarly, students reported strong adaptability in balancing academic work with other responsibilities ($M = 4.19$, $SD = .785$) and in preparing differently for exams depending on the subject ($M = 4.17$, $SD = .764$), highlighting

their ability to modify strategies to suit situational requirements. Slightly lower but still strong mean values were observed for managing time under increased academic demands ($M = 4.11$, $SD = .829$) and changing participation style according to classroom dynamics ($M = 4.10$, $SD = .881$). The relatively consistent scores across all items suggest that students possess well-developed behavioral adaptability skills, with particular strengths in social and strategic adjustments, while flexibility in time management and participation style, though still positive, represent comparatively less emphasized areas. These findings underscore a balanced yet slightly differentiated profile of behavioral adaptability among the student sample.

Table 11

Description of Emotional Adaptability (managing stress, motivation, and emotional reactions to challenges)

Items	Mean	S.D.
I stay motivated even when coursework is more difficult than expected.	4.16	.824
I remain calm and focused when faced with academic pressure.	4.20	.848
I adapt my mindset to stay positive when I encounter academic setbacks.	4.40	.780
I am able to recover quickly after performing poorly in an exam or assignment.	4.18	.838
I adjust my expectations and effort when I face academic challenges.	4.23	.820

The results presented in Table 11 illustrate students' perceptions of their emotional adaptability in academic settings, focusing on their ability to manage stress, sustain motivation, and regulate emotional responses during challenging circumstances. Overall, the mean scores for all items are above 4.0,

indicating a consistently high level of agreement among students that they are capable of adapting emotionally when confronted with academic pressures. The highest mean score ($M = 4.40$, $SD = .780$) was recorded for the statement "I adapt my mindset to stay positive when I encounter academic setbacks," suggesting that

students demonstrate strong resilience and a constructive outlook in the face of academic difficulties. This finding reflects their capacity to maintain optimism and persistence despite encountering challenges. Similarly, the item “*I adjust my expectations and effort when I face academic challenges*” ($M = 4.23$, $SD = .820$) and “*I remain calm and focused when faced with academic pressure*” ($M = 4.20$, $SD = .848$) show that students can effectively regulate stress and maintain concentration, which are crucial components of emotional adaptability. Moderately high mean scores were also

observed for “*I am able to recover quickly after performing poorly in an exam or assignment*” ($M = 4.18$, $SD = .838$) and “*I stay motivated even when coursework is more difficult than expected*” ($M = 4.16$, $SD = .824$). These results suggest that while students are generally able to sustain motivation and recover from setbacks, these areas may require additional reinforcement compared to their ability to adopt a positive mindset. The relatively small standard deviations across all items indicate a strong consensus among students, with minimal variability in their responses.

Table 12

Relationship between metacognitive (Knowledge and Regulation) awareness and academic adaptability

		Correlations		
		Metacognitive Knowledge	Metacognitive Regulation	Academic Adaptability
Metacognitive Knowledge	Pearson Correlation	1	.630**	.749**
	Sig. (2-tailed)		.000	.000
	N	500	500	500
Metacognitive Regulation	Pearson Correlation	.630**	1	.394**
	Sig. (2-tailed)	.000		.000
	N	500	500	500
Academic Adaptability	Pearson Correlation	.749**	.394**	1
	Sig. (2-tailed)	.000	.000	
	N	500	500	500

** . Correlation is significant at the 0.01 level (2-tailed).

The results presented in Table 12 demonstrate significant positive correlations among metacognitive knowledge, metacognitive regulation, and academic adaptability. A strong correlation was observed between metacognitive knowledge and academic adaptability ($r = .749$, $p < .01$), suggesting that students with greater awareness of their own cognitive processes are better able to adjust their learning strategies and cope with academic challenges. The relationship between metacognitive knowledge and metacognitive regulation was also strong ($r = .630$, $p < .01$), indicating that students who possess greater

knowledge about their cognition are more likely to effectively regulate and monitor their learning behaviors. Additionally, metacognitive regulation was found to have a moderate positive correlation with academic adaptability ($r = .394$, $p < .01$). This finding implies that while the ability to regulate learning contributes to adaptability, it is not as strong a predictor as metacognitive knowledge. Overall, the results highlight that both knowledge and regulation of cognition play important roles in shaping students' capacity to adapt academically, with knowledge exerting a more substantial influence on adaptability outcomes.

Table 13

Effect of metacognitive (Knowledge and Regulation) awareness on academic adaptability

ANOVA ^a						
	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	75.860	2	37.930	331.117	.000 ^b
	Residual	56.932	497	.115		
	Total	132.791	499			
a. Dependent Variable: Academic Adaptability						
b. Predictors: (Constant), Metacognitive Regulation, Metacognitive Knowledge						

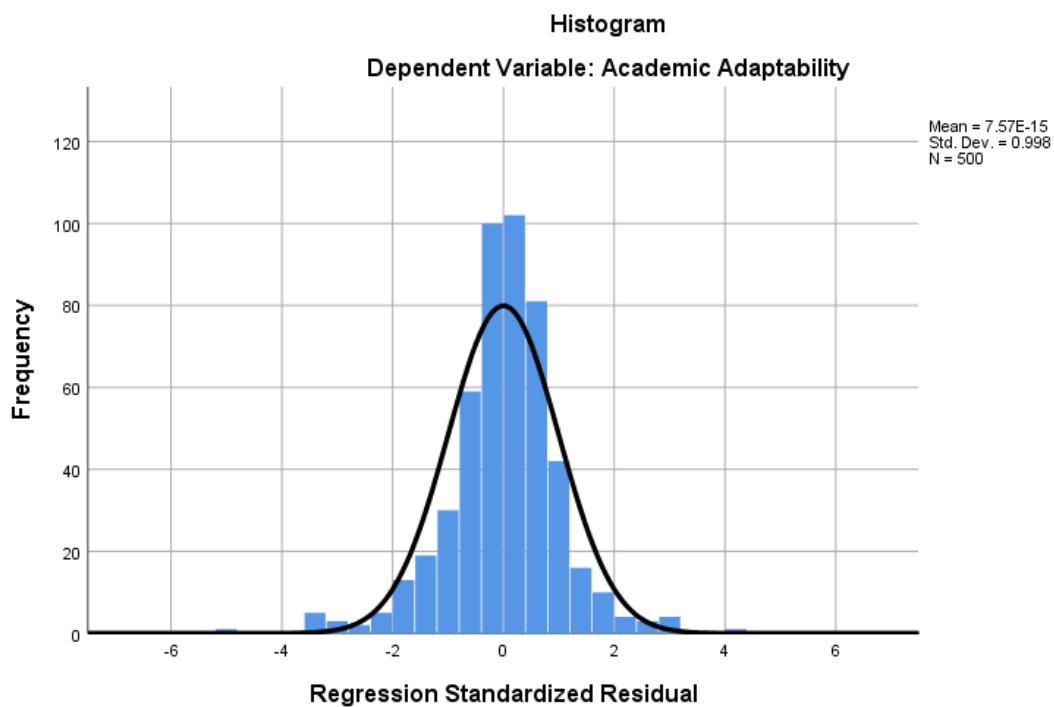
The results in Table 13 demonstrate that metacognitive awareness, consisting of both knowledge and regulation, has a statistically significant impact on academic adaptability. The regression model yielded an F-value of 331.117 ($p < .001$), confirming that the predictors collectively account for a substantial

proportion of the variance in academic adaptability. The model explains a large share of the variability, as indicated by the regression sum of squares (75.860) compared to the residual sum of squares (56.932), highlighting the strong explanatory power of metacognitive awareness.

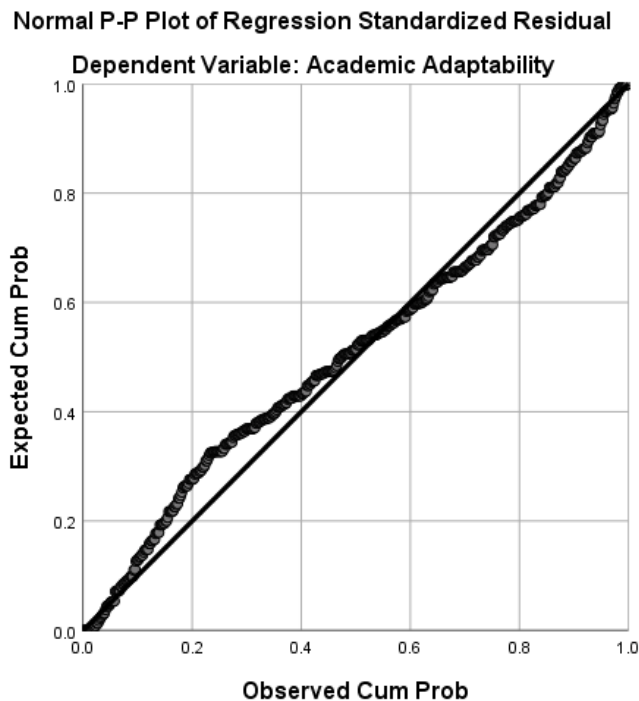
Table 14

Effect of metacognitive (Knowledge and Regulation) awareness on academic adaptability

Coefficients ^a						
		Unstandardized Coefficients		Standardized Coefficients		
	Model	B	Std. Error	Beta	t	Sig.
1	(Constant)	-.015	.175		-.083	.933
	Metacognitive Knowledge	1.145	.052	.830	21.964	.000
	Metacognitive Regulation	-.136	.040	-.129	-3.409	.001
a. Dependent Variable: Academic Adaptability						



Graph 1: Effect of metacognitive (Knowledge and Regulation) awareness on academic adaptability



Graph 2: Effect of metacognitive (Knowledge and Regulation) awareness on academic adaptability

Table 14 provides further insight into the individual contributions of metacognitive knowledge and regulation. Metacognitive knowledge shows a strong positive and highly significant effect on academic adaptability ($B = 1.145$, $\beta = .830$, $t = 21.964$, $p < .001$), indicating that higher levels of metacognitive knowledge substantially enhance students' ability to adapt academically. Conversely, metacognitive regulation demonstrates a small but significant negative effect ($B = -.136$, $\beta = -.129$, $t = -3.409$, $p = .001$), suggesting that in this model, greater emphasis on regulation slightly decreases adaptability when knowledge is already accounted for. The non-significant constant ($p = .933$) shows that adaptability is predominantly shaped by these metacognitive components rather than other unmeasured factors in the model. Collectively, these findings emphasize that metacognitive knowledge serves as the dominant predictor of academic adaptability, while metacognitive regulation plays a secondary but inverse role when both constructs are considered simultaneously.

Discussion

The findings of this study highlight that metacognitive knowledge is a powerful predictor of academic adaptability, whereas metacognitive regulation demonstrates a smaller, though significant, negative effect when both constructs are considered together. The strong positive relationship between metacognitive knowledge and adaptability suggests that students who are more aware of their cognitive processes, strategies, and learning contexts are better equipped to adjust their academic behaviors and strategies when faced with challenges. This aligns with previous literature emphasizing the critical role of metacognitive knowledge in fostering flexibility, problem-solving, and self-regulated learning behaviors that enable students to adapt effectively in diverse educational contexts

(Mädämürk et al., 2020; Liu et al., 2022). Declarative, procedural, and conditional knowledge allow learners to not only understand their strengths and weaknesses but also to decide when and why to apply specific strategies, thereby enhancing their cognitive, behavioral, and emotional adaptability (Veenman & van Cleef, 2019; Putri et al., 2021).

Interestingly, the negative effect of metacognitive regulation, once knowledge was accounted for, suggests a possible redundancy or overregulation in students' approaches. This may occur when excessive focus on planning, monitoring, or controlling learning behaviors creates rigidity rather than flexibility, thereby limiting adaptability. Recent studies caution that while regulation is essential, its benefits are maximized only when balanced with sufficient metacognitive knowledge that guides the use of regulatory processes (Zhou & Yu, 2021; Hong et al., 2023). Over-monitoring or over-adjusting without a solid base of knowledge may lead to cognitive overload, which can hinder adaptive responses in complex academic environments (Panadero, 2017; Jiang et al., 2022). Therefore, these findings underscore the nuanced interaction between knowledge and regulation: knowledge provides the foundation for adaptive learning, while regulation supports it, but an imbalance can reduce effectiveness.

Overall, the study contributes to ongoing discussions in the literature that academic adaptability is most effectively developed through enhancing metacognitive knowledge as a priority, while also fostering balanced regulatory skills. Recent empirical evidence further supports that adaptability in academic settings is linked to resilience, academic success, and wellbeing, and is most sustainable when rooted in robust metacognitive awareness (Collie et al., 2020; Datu & Yuen, 2022). Thus, these results extend prior work by demonstrating the relative importance of

knowledge over regulation in predicting adaptability and highlight the need for educational interventions that focus on developing students' awareness of their learning processes alongside efficient, non-redundant regulatory practices.

Conclusion

The findings of this study conclude that metacognitive knowledge serves as a stronger and more consistent predictor of academic adaptability compared to metacognitive regulation. Students with well-developed declarative, procedural, and conditional knowledge are better able to evaluate learning demands, select appropriate strategies, and flexibly adjust to academic challenges, thereby enhancing their adaptability. While metacognitive regulation remains important, its negative influence when combined with knowledge suggests that excessive regulation without a solid knowledge base may hinder adaptability by fostering cognitive overload or rigidity. This emphasizes the need for a balanced development of both metacognitive components, with knowledge forming the foundation and regulation acting as supportive processes. Overall, academic adaptability is best cultivated through awareness-driven learning practices that foster resilience, flexibility, and engagement, which are increasingly essential for success in higher education and beyond.

RECOMMENDATIONS

- Higher education institutions should integrate explicit instruction on declarative, procedural, and conditional knowledge into courses to strengthen students' understanding of when and how to apply learning strategies.
- Workshops should focus on teaching effective regulation strategies such as planning and monitoring but with emphasis on avoiding over-regulation that may cause cognitive overload.

- Universities should design adaptive learning systems that provide feedback aligned with students' metacognitive knowledge levels, supporting both flexibility and efficiency in self-regulation.
- Students should be encouraged to use reflective journals, peer feedback, and guided questioning to deepen their awareness of learning processes, enhancing adaptability across academic contexts.
- Educators should be trained to embed metacognitive prompts and adaptability-focused activities within teaching, ensuring that instruction goes beyond content delivery to support learners' self-awareness and strategic flexibility.
- Targeted interventions should be offered for students with low adaptability, focusing on strengthening metacognitive knowledge before advancing to regulation-based practices.
- Digital platforms and learning management systems should be used to scaffold metacognitive awareness and adaptability, through features like self-assessment quizzes, progress dashboards, and adaptive pathways.

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