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Enhancing Critical Thinking through Collaborative Learning: The Mediating Roles of Peer Interaction and Self-Efficacy

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ABSTRACT

The effect of collaborative learning (CL) on critical thinking among students within a higher education institute in Karachi and Pakistan with mediating variables of peer interaction (PI) and self-efficacy (SE) is studied in this study. Critical thinking (CT) is the key to academic success yet its development usually requires interaction and the confidence in their skills of students. The causal quantitative research design was adopted and 222 surveys were given to the undergraduate and post graduate students of various universities in Karachi. The survey instruments were modified based on prior researches that are valid in order to be reliable and consistent. Structural Equation Modelling (SEM) with Partial Least Squares (PLS) was used to analyse the data. Findings demonstrate that CL positively impacts massively on the CT of students. Furthermore, PI and SE were identified to have significant mediation effect of this correlation which emphasised the need to establish supportive peer networks and instil confidence in students regarding their academic abilities. These results imply that institutions of higher learning in Karachi have the potential to improve CT through either a structured CL activity or by facilitating the creation of a culture where students actively engage. The present research is relevant to the body of research on educational psychology and pedagogical practises, as it offers practical implications to teachers who would like to foster students in developing higher-order thinking skills and self-directed learning

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1. Introduction

Critical thinking (CT) has become a core competency in higher education, enabling students to analyse complex problems, make informed decisions, and reflect effectively. In today's knowledge-driven societies, information acquisition alone is insufficient; students must develop higher-order skills to synthesise, evaluate, and apply information efficiently (Awad et al., 2025). However, higher education institutions in Pakistan continue to rely heavily on lecture-based pedagogies that often fail to promote CT or active engagement (Aldabousi, 2023). This highlights the need to examine teaching methods that genuinely enhance CT, particularly within Karachi's

evolving educational landscape. Collaborative learning (CL) is widely recognised as a method that encourages active participation and fosters CT. Through peer interaction (PI), students are exposed to diverse viewpoints, challenged to defend their ideas, and encouraged to consider alternative perspectives—key components of cognitive development (Awad, 2025). PI strengthens dialogue, knowledge sharing, and collective problem-solving, thereby improving analytical skills (Aldabousi, 2023). Self-efficacy (SE)—students' belief in their ability to succeed academically—also plays a vital role in determining persistence and engagement. Higher SE is linked with improved reasoning, motivation, and intellectual risk-taking, all of which support CT development (Awad et al., 2025). These three variables work synergistically: CL provides the structure, PI strengthens cognitive and social processes, and SE enhances students' confidence to engage with complex concepts.

Karachi's major public and private universities, including the University of Karachi, NED University of Engineering and Technology, and Bahria University, host a diverse student population with varying pedagogical experiences. Although student-centred approaches are gradually being adopted, persistent issues—large class sizes, limited interaction, and minimal emphasis on higher-order thinking—continue to hinder CT development (Nazil, 2025). Current statistics show that only a minority of university students regularly engage in collaborative or analytical work, underscoring the need for empirical research on effective CT-enhancing strategies (Qadeer & Awad, 2025). Extensive literature has highlighted the importance of CT in higher education, yet several gaps persist. For instance, Awad et al. (2025) found that CL positively affects CT but did not examine PI as a mediating mechanism. Aldabousi (2022) identified SE as a predictor of learning outcomes but did not explore its interaction with CL models. An et al. (2022) reported low student engagement in Pakistani universities but did not provide empirical models linking engagement, PI, and CT. Nazil (2025) reviewed CL globally but noted the limited evidence from South Asia. Qadeer and Awad (2025) emphasised higher-order thinking but did not integrate motivational or social-cognitive factors such as SE and PI. Although Awad et al. (2025) stressed the need for locally validated learning models, most existing research is based on Western contexts and cannot be directly applied to Pakistan. There is no context-specific model in Pakistan examining how collaborative learning influences critical thinking through the mediating roles of peer interaction and self-efficacy.

Therefore, this study is necessary to address this gap. Its main objectives are to:

1. Examine the effect of collaborative learning on students' critical thinking.

2. Determine the mediating role of peer interaction in this relationship.

3. Determine the mediating role of self-efficacy in this relationship.

4. Provide evidence-based insights for improving pedagogical practices in Pakistani universities.

Using a quantitative causal design, 222 questionnaires were administered across selected universities. Validated survey instruments ensured construct accuracy, and PLS-SEM was employed to analyse both direct and mediating relationships among CL, PI, SE, and CT. This approach allows for a robust assessment of how these variables interact to influence cognitive development. The study contributes to policy, curriculum design, and instructional practice by offering an empirically grounded framework tailored to Pakistan's higher education context. Ultimately, it presents a holistic model demonstrating how CT can be strengthened through the strategic integration of CL, PI, and SE—skills essential for students' academic and professional success.

2. Theoretical Background

Critical thinking (CT), understood as the ability to analyse, evaluate, and apply information, develops through both cognitive and social processes. To explain how CT emerges within collaborative academic environments, this study integrates three complementary theoretical lenses: Social Constructivism Theory, Social Cognitive Theory, and Collaborative Learning Theory. Together, these frameworks support the conceptual model by clarifying how collaborative learning (CL), peer interaction (PI), and self-efficacy (SE) function as interconnected mechanisms shaping CT. For conceptual clarity, Collaborative Learning (CL) refers to structured group-based activities where students jointly solve problems and construct knowledge; Peer Interaction (PI) refers to cognitively rich exchanges such as discussion, questioning, and feedback; Self-Efficacy (SE) refers to students' beliefs in their academic capability; and Critical Thinking (CT) refers to analytical reasoning and the ability to make justified judgments. Social Constructivism, rooted in Kozolin (1986), posits that knowledge is constructed through social engagement rather than individual effort. Learning is viewed as a communal activity where students develop understanding through dialogue, discussion, and collaborative problem-solving (Awad, 2025). Empirical studies reinforce this foundation: collaborative settings enhance reasoning (Al-Fahim et al., 2024), promote higher-order thinking (Awad & Mahmoud, 2024), and support knowledge integration through peer discussion (Alkadash et al., 2023). Peer scaffolding strengthens problem-solving (Al-Maamari et al., 2021), and active dialogue encourages reflection and justification (Gupta & Nagi, 2025).

Additional evidence indicates that socially mediated learning improves analytical thinking (Hussain, 2023), adaptive learning strategies (Nagi, 2024), cognitive flexibility (Nazil, 2025), knowledge transfer (Aldabousi et al., 2025), and academic performance via shared cognitive responsibility (Awad et al., 2024). These findings collectively establish PI as a central mechanism through which social constructivist processes transform CL experiences into enhanced CT. Accordingly, the theory directly supports the hypothesis that CL improves CT through increased PI. While Social Constructivism explains the social dimension of learning, Social Cognitive Theory (Bandura, 1997) highlights the motivational dimension by emphasising the role of SE. According to this perspective, learners' beliefs in their capabilities influence their motivation, persistence, and willingness to engage in cognitively demanding tasks. SE therefore shapes how effectively

students participate in CL and employ CT strategies (Awad et al., 2025). The literature is consistent on this point: higher SE leads to increased cognitive engagement (Awad et al., 2024), stronger problem-solving skills (Aldabousi, 2025), heightened motivation (Al-Ramahi et al., 2024), and more constructive group learning (Awad & Aldabousi, 2024). Studies further show that SE mediates the relationship between CL and outcomes such as cognitive development (Pan et al., 2024), resilience (Nagi et al., 2024), reasoning (Gupta & Nagi, 2025), reflection (Qadeer & Awad, 2025), and knowledge retention (Obeidat et al., 2024).

Together, these results validate SE as a key psychological mechanism through which collaborative environments enhance CT. Based on Social Cognitive Theory, the model therefore hypothesises that CL improves CT through increased SE. Complementing the two perspectives above, Collaborative Learning Theory conceptualises learning as an interactive, structured process involving shared goals and group-based cognitive efforts (Awad & Aldabousi, 2024). This theory underscores how CT is strengthened through structured tasks, peer feedback, and co-construction of knowledge. Empirical studies confirm that CL supports analytical skills (Ghonim & Awad, 2024), strengthens argumentation quality (Armutcu et al., 2025), enhances metacognitive awareness (Yadav et al., 2021), and improves reasoning (Saad et al., 2025). CL is also associated with greater engagement (Qadeer et al., 2025), motivation (Sari, 2025), cognitive flexibility (Yusuf et al., 2025), knowledge application (Sharma & Nagi, 2018), and academic performance (Fathallah & Nagi, 2024). This evidence demonstrates that CL provides the structural conditions necessary for PI and SE to operate effectively, thereby supporting the hypothesised mediating pathways. When combined, these theories provide a comprehensive explanation of how CL strengthens CT. Social Constructivism explains the social-cognitive pathway, CL → PI → CT. Social Cognitive Theory explains the motivational pathway, CL → SE → CT. Collaborative Learning Theory explains the structural pathway that enables both mechanisms. Integrating these perspectives addresses theoretical gaps by clarifying the mechanisms through which CL translates into CT, particularly in the Pakistani higher education context where collaborative structures and confidence-building practices remain underutilised. The combined framework thus supports the study's hypotheses by specifying why CL influences CT and how PI and SE serve as essential mediators in this relationship.

2.1 Collaborative learning and Critical Thinking

Collaborative Learning (CL) is theorised to significantly enhance students' Critical Thinking (CT) because it immerses learners in environments characterised by dialogue, shared reasoning, and collective cognitive engagement. Grounded in Social Constructivism Theory, learning is viewed as a social act where understanding emerges through argumentation, negotiation of meaning, and joint construction of knowledge (Nagi et al., 2025). Through dialogue, peer scaffolding, and collaborative problem-solving, CL nurtures analytical reasoning and evaluative judgement—core elements of CT (Awad et al., 2024; Brahmi et al., 1988). Social Cognitive Theory further explains that collaborative environments stimulate learning through observation, modelling, and reciprocal feedback, enabling students to acquire effective reasoning strategies and self-regulatory behaviours that contribute to CT (Alghizzawi et al., 2025; Nagi et al., 2021; Ghonim &

Awad, 2025). Likewise, Collaborative Learning Theory posits that positive interdependence, promotive interaction, and shared responsibility foster reflective discourse and higher-order thinking (Khan et al., 2023; Abdulrahim et al., 2024; Alfiras et al., 2021). Empirical evidence consistently confirms that structured CL interventions enhance analytical reasoning, argumentation, and reflective judgement (El Gareh et al., 2025; Khan et al., 2024).

H_1: *CL significant effect on students' CT.*

2.2 Collaborative Learning and Peer Interaction

CL is inherently dependent on Peer Interaction (PI), as collaboration requires learners to exchange ideas, co-construct meaning, and jointly solve problems. Social Constructivism Theory emphasises that deep learning arises from social discourse where peers participate as co-creators of knowledge (Almeer et al., 2024). Through continuous interaction, learners expose themselves to diverse viewpoints, refine assumptions, and strengthen cognitive processes (Awad & Ghonim, 2025; Nagi & Bajiah, 2020). From the lens of Social Cognitive Theory, PI enhances learning through modelling, feedback, and verbal persuasion, which collectively strengthen motivation and cognitive growth (Al-sherman & Aldabousi, 2024; Mahmoud et al., 2025; Nagi & Nigam, 2023). Collaborative Learning Theory identifies PI as the central mechanism through which CL produces meaningful academic benefits—promotive interaction, shared goals, and active dialogue increase engagement and depth of understanding (Hussain et al., 2023; Nagi et al., 2025). Empirical studies demonstrate that PI predicts improved learning outcomes, communication skills, and CT (Mahmoud et al., 2025; Nagi & Mohammed Ali, 2020).

H2: CL positively influences PI.

2.3 Collaborative Learning and Self-Efficacy

CL is also expected to increase students' Self-Efficacy (SE) because collaborative environments provide supportive conditions that build confidence, motivation, and belief in one's academic abilities. Social Cognitive Theory defines SE as an individual's belief in their capacity to perform tasks and achieve goals (Nagi & Singh, 2025). In CL settings, students benefit from modelling, successful group mastery experiences, verbal reinforcement, and peer support—all primary sources of SE (Hussain, 2023; Saeed Almanbahi et al., 2025; Yahia Shams Eldin et al., 2025). Social Constructivism Theory further explains that through co-construction of knowledge and participation in meaningful group contributions, learners internalise shared experiences and develop greater confidence in their competence (Nagi et al., 2023; Awad & Aldabousi, 2024; Aldabousi, 2023). Collaborative Learning Theory reinforces that positive interdependence, group cohesion, and shared success enhance learners' beliefs in their abilities and motivation to perform (Khalifa et al., 2020; Murthy et al., 2025). Consistent empirical findings show that CL interventions reliably increase SE across academic contexts (Nagi & Singh, 2025; Mari & Hussain, 2021).

H_3: *CL positively influences students' SE.*

2.4 Peer Interaction and Critical Thinking

PI is theorised to enhance CT because interaction forms the social–cognitive foundation for deeper thinking. Social Constructivism Theory states that cognitive development arises from shared meaning-making and co-mediated reasoning (Wahid & Awad, 2025). Through peer dialogue, learners negotiate meanings, challenge assumptions, and defend positions—activities that directly stimulate higher-order and reflective thinking (Awad et al., 2025; Aldabousi, 2023). Social Cognitive Theory explains that PI facilitates observational learning and feedback, enabling students to internalise effective reasoning strategies and problem-solving behaviours (Wang & Shan, 2018; Nagi & Nigam, 2023). Collaborative Learning Theory emphasises that promotive interaction enhances analytical engagement and cognitive elaboration (Aldabousi, 2024; Awad, 2025). Empirical findings show that structured PI-such as debate, peer review, and small-group discussion—strongly enhances reasoning, reflective judgement, and synthesis of diverse viewpoints (Awad, 2024; Hussain, 2023).

H4: PI has a positive and significant influences on CT.

2.5 Self-efficacy and Critical thinking

SE is also theorised to positively influence CT because students who believe in their academic capabilities show greater persistence, cognitive effort, and willingness to engage in complex reasoning tasks. Social Cognitive Theory establishes that SE shapes cognitive, motivational, and affective processes essential for learning (Nagi, 2024; Nagi & Singh, 2025; Obeidat et al., 2024). Learners with high SE are more capable of evaluating information, constructing arguments, and solving problems. Social Constructivism Theory complements this view by recognising that students with high SE actively participate in dialogue, justify opinions, and respond to feedback—behaviours that build evaluative and reflective capacities (Aldabousi, 2025; Aldabousi, 2024; Armutcu et al., 2025). According to Collaborative Learning Theory, self-efficacious learners contribute more actively to group reasoning, take intellectual risks, and engage more deeply with analytical tasks (Gupta & Nagi, 2025). Empirical research consistently links higher SE with stronger CT performance (Khan et al., 2024; Muskan Nagi, 2022; Nagi et al., 2023).

H_5: *SE positively influences students' CT.*

2.6 Peer Interaction as a Mediator

PI and SE are positioned as mediators because CL provides the structural and social environment, but the cognitive benefits of CL materialise only when students meaningfully interact (PI) and develop confidence in their abilities (SE). PI activates social constructivist mechanisms that spark deeper reasoning, while SE activates motivational mechanisms that sustain effortful thinking. Thus, both processes translate CL into measurable CT gains. The relationship between CL and CT is therefore expected to be mediated by PI. From a Social Constructivism perspective, CL creates the setting for collaborative engagement, but it is through PI—dialogue, argumentation, negotiation of meaning—that students internalise new concepts and activate higher-order

cognition (Qadeer & Awad, 2025; Wahid & Awad, 2025; Alghizzawi et al., 2025; Brahmi et al., 1988). From a socio-cognitive viewpoint, PI enables observational learning and reciprocal feedback, further supporting the acquisition of reasoning strategies (Al-Maamari et al., 2021). Collaborative Learning Theory adds that positive interdependence and promotive interaction convert collective engagement into individual cognitive growth (Khalifa et al., 2020; Nagi et al., 2024; Pan et al., 2024). Empirical studies confirm that PI quality determines whether CL leads to CT (Awad & Ghonim, 2025; Nagi, 2024).

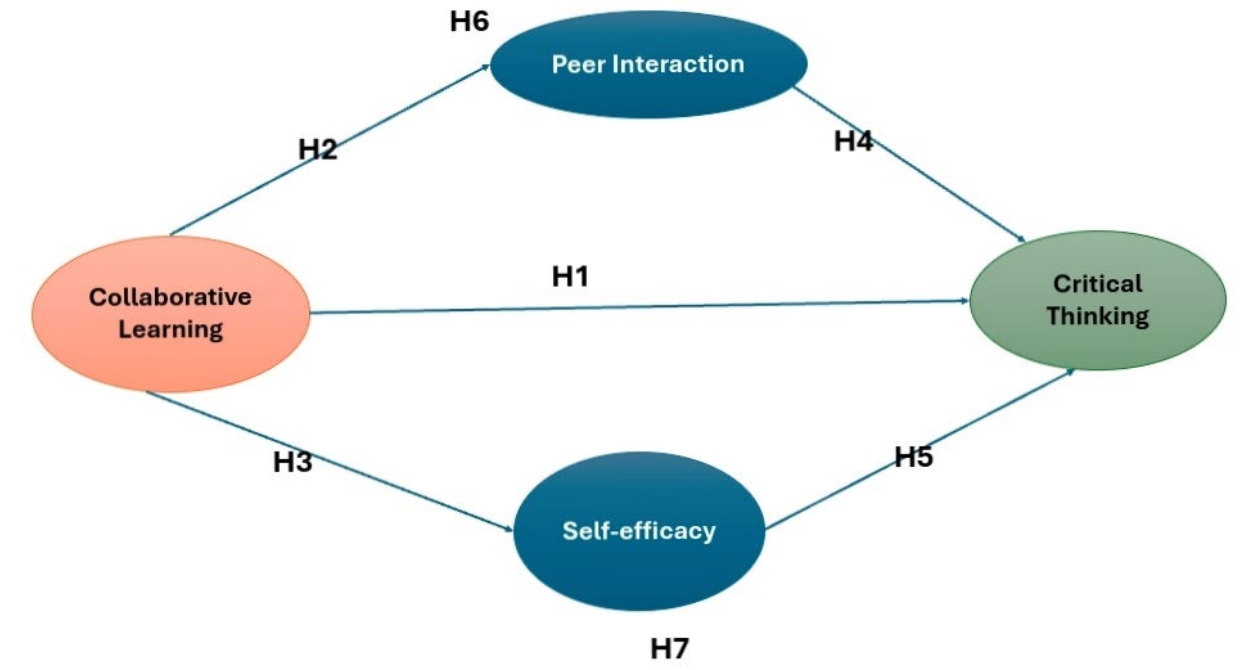
H 6: PI mediates in the relationship between the relationship of CL and CT.

2.7 Self-Efficacy as a Mediator

PI and SE serve as mediators in this model because both constructs represent essential psychological and cognitive mechanisms that translate collaborative learning experiences into higher-order thinking outcomes. Collaborative Learning (CL) provides social interaction, feedback, and shared problem-solving conditions. These conditions enhance Psychological Investment (PI) by increasing students' engagement, motivation, and personal commitment to learning (Awad & Aldabousi, 2024). At the same time, CL strengthens Self-Efficacy (SE) by facilitating mastery experiences, peer modelling, and positive reinforcement, as proposed by Social Cognitive Theory (Hussain et al., 2023; Aldabousi, 2023). When students perceive themselves as capable and personally invested, they are more inclined to engage in deeper reasoning, reflective judgment, and critical analysis—core components of Critical Thinking (CT) (Sari, 2025; Awad et al., 2024). Collaborative learning further aligns with Social Constructivism, which emphasises meaning-making through dialogue, negotiation, and shared cognitive tasks (Hussain et al., 2023). These processes enhance students' confidence and academic self-beliefs, which in turn strengthen their willingness to question assumptions, deconstruct arguments, and generate independent solutions—central dimensions of CT (Alghizzawi et al., 2025; An et al., 2022). Collaborative Learning Theory also suggests that positive interdependence and collective goal-orientation foster both empowerment and self-efficacy, enabling students to engage in complex reasoning and problem-solving (Ghonim et al., 2025; Nazil, 2025). Empirical studies consistently confirm that SE and PI mediate the effects of collaborative learning on cognitive outcomes, demonstrating that students with higher confidence and personal engagement show stronger analytical performance, resilience, and cognitive flexibility (Maher Alhalawany et al., 2021; Al-Fahim et al., 2024). Based on this theoretical and empirical foundation, the following hypotheses are proposed:

H_7: *Self-efficacy mediates the relationship between collaborative learning and critical thinking*

Figure 1. Conceptual Model



3. Methodology

The study employed a quantitative causal research design to examine the effect of CL on students' CT with the mediating roles of PI and SE. This design was appropriate because it enables the empirical testing of directional hypotheses and the examination of underlying mechanisms between variables (Awad, 2025). Data were collected over a three-month period (January–March 2025), allowing sufficient time for distribution, cleaning, and validation. The target population consisted of undergraduate and postgraduate students from major universities in Karachi—the University of Karachi, NED University of Engineering and Technology, and Bahria University. These institutions were selected due to their diverse student bodies and established use of student-centred and collaborative learning practices, making them an appropriate context for investigating CT development. Demographically, respondents represented a balanced mix of programmes and study levels, ensuring variability in academic exposure while maintaining relevance to CL experiences. A total of 250 questionnaires were distributed both online (Google Forms) and offline (classroom-based). After screening for completeness and consistency, 222 valid responses were retained (effective response rate = 88.8%), which is considered strong for social science studies. The sample size exceeded the recommended threshold for SEM—at least 5–10 times the number of indicators (Obeidat et al., 2024)—confirming its adequacy for robust mediation analysis. A structured questionnaire consisting of 44 items across four constructs was used CL (10 items; Aldabousi et al., 2025). PI (12 items; Awad & Aldabousi, 2024). SE (12 items; Hussain, 2023). CT (10 items; Awad et al., 2025). All items were measured on a 5-point Likert scale

(1 = strongly disagree; 5 = strongly agree). Instrument adaptation ensured contextual relevance to Pakistani higher education. A pilot test with 30 students helped refine item clarity, and Harman's single-factor test confirmed minimal common method bias (28% variance < 50% threshold) (Nagi et al., 2021). For data analysis, PLS-SEM was conducted using appropriate statistical software, given its suitability for complex conceptual models, mediation testing, non-normal data, and prediction-oriented approaches. Ethical protocols—including informed consent, voluntary participation, and confidentiality—were strictly observed throughout data collection.

4. Results

The sample of the study included 222 university students of the major higher education institutions located in Karachi, Pakistan, the University of Karachi, NED University of Engineering and Technology, and the Bahria University. According to the demographic analysis, the number of males is a little higher 58.1 per cent (129 respondents) and the number of females is 41.9 per cent (93 respondents) as the statistics show the enrollment count of the STEM and social science programmes in these institutions. Age wise, the highest number were 2025 years (45.0,100) and 2630 years (35.1,78), as is normal in undergraduate and early postgraduate students. In terms of educational qualification, most of the respondents were undergraduates (Bachelors, 50.0, 111 respondents), then there are students with Associate degrees (20.7, 46 respondents). The number of postgraduate students with Master-degree was 17.6% (39 respondents) and Doctoral students were 11.7% (26 respondents), which represents the variety of the academic level involved in CL processes. Involvement in organised CL was spread equally amongst institutions where 56.8% (126 respondents) indicated they were regularly involved in group projects, discussion and workshops led by peers. Regarding employment or internship experience 40.1% (89 respondents) had some prior experience of internship, 35.6% (79 respondents) had some experience of part-time job experience and 24.3% (54 respondents) had no formal work exposure, so it is evident that many participated in less practical work levels. Most of the students (62.2, 138 respondents) lived in urban Karachi with the rest (37.8, 84 respondents) living in suburban or peri-urban localities. Students were largely part-time, 61.3% (136 respondents) of students were taking internships or part time employment to complement their studies and 38.7% (86 respondents) students were not employed at the time of the research.

Table 1. Demographic Profile of Respondents (n = 222)

Demographic Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	129	58.1
	Female	93	41.9
Age	20–25 years	100	45.0
	26–30 years	78	35.1
	31–35 years	44	19.8
Education Level	Associate Degree	46	20.7
	Bachelor's Degree	111	50.0
	Master's Degree	39	17.6

	Doctoral Degree	26	11.7
Residence	Urban Karachi	138	62.2
	Suburban/Peri-urban	84	37.8
Employment/Internship Experience	Internship	89	40.1
	Part-time Work	79	35.6
	None	54	24.3
Employment Status	Part-time/Internship	136	61.3
	Not Employed	86	38.7

4.1 Reliability, Validity, and Model Evaluation

The measurement instruments demonstrated strong reliability and validity. Cronbach's alpha, composite reliability (CR), and rho_A values for all constructs exceeded 0.70, while Average Variance Extracted (AVE) values were above 0.50, confirming convergent validity (Alfiras et al., 2021). Variance Inflation Factor (VIF) values were below 5, indicating no multicollinearity. The explanatory power of the model was reflected in the R^2 values: PI = 0.412, SE = 0.658, and CT = 0.781. Predictive relevance (Q^2) assessed via blindfolding was 0.913, confirming the model's predictive capability (Hair et al., 2017). PLS-SEM analysis was conducted in SmartPLS using 5,000 bootstrap samples to determine path significance. The results provide a robust foundation for testing the hypothesised relationships among CL, PI, SE, and CT in Table 2.

Table 2. Reliability, Validity, and Model Evaluation Results

Variable	Cronbach's Alpha	rho_A	Composite Reliability (CR)	Average Variance Extracted (AVE)	R^2	VIF
CL	0.914	0.711	0.928	0.502	–	1.45
PI	0.887	0.729	0.912	0.538	0.412	1.37
SE	0.902	0.742	0.920	0.521	0.658	1.42
CT	0.891	0.735	0.914	0.495	0.781	1.39

4.2 Hypothesis Testing and Structural Model Results

Structural model was considered to test the direct and indirect impacts between the variables of CL, PI, SE, and CT. The findings reveal that the proposed model is correct as all the hypothesised relationships are positive and statistically significant. In particular, CL has a positive impact on PI that is strong (path coefficient of 0.542) ($p < 0.001$) which means that the more students are involved in organised CL, the more they are likely to have substantial PI. On the same note, the effects of CL have a positive impact on SE (0.503, $p < 0.001$), which implies that group-based learning boosts the confidence of learners in their academic abilities. The two mediators, PI (= 0.241, $p = 0.003$) and SE (= 0.312, $p = 0.001$) have a positive impact on CT, which proves their central mediating roles in transforming CL into higher-order cognitive skills. Indirect effects were also important. The hypothesised mediating mechanisms are supported by the fact that CL has a positive effect on CT by PI (= 0.130, $p = 0.007$) and by SE (= 0.157, $p = 0.002$). These results point

to the fact that, although there is a direct influence of CL (= 0.396, p < 0.001) on CT, much of this effect is mediated by improved PI and SE of students, showing the relevance of social and motivational processes in higher education settings.

Table 3. Hypothesis Testing Results

Hypothesis	Path	Beta (β)	T-Statistics	p-value	Decision
H1	CL➔ CT	0.396	5.892	0.000	Accepted
H2	CL ➔ PI	0.542	7.120	0.000	Accepted
H3	CL➔ SE	0.503	6.451	0.000	Accepted
H4	PI➔ CT	0.241	2.984	0.003	Accepted
H5	SE ➔ CT	0.312	3.410	0.001	Accepted
H6	CL ➔ PI ➔ CT	0.130	2.684	0.007	Accepted
H7	CL➔ SE➔ CT	0.157	3.104	0.002	Accepted

5. Discussion

This study examined the impact of collaborative learning (CL) on critical thinking (CT) among university students in Karachi, Pakistan, with peer interaction (PI) and self-efficacy (SE) as mediators. The findings indicate that CL positively influences CT both directly and indirectly through PI and SE, supporting the combined theoretical lens of Social Constructivism, Social Cognitive, and Collaborative Learning theories. The direct effect of CL on CT aligns with previous studies highlighting that structured group-based learning enhances analytical and evaluative skills (Al-sherman & Aldabousi, 2024; Al-Maamari et al., 2021). This suggests that even within a traditionally lecture-based educational system, interactive pedagogical approaches can effectively foster higher-order cognitive skills (An et al., 2022). PI was confirmed as a significant mediator, indicating that collaborative interaction among peers channels the influence of CL toward CT. This finding supports Social Constructivist perspectives, which posit that knowledge is constructed through social interaction and co-construction (Murthy et al., 2025). Consistent with Awad et al. (2025) and Alghizzawi et al. (2025), students engaged in meaningful peer discussions demonstrated improved reasoning and problem-solving abilities. Some prior studies, however, have reported smaller PI effects due to unequal participation or dominance by certain group members (Alfiras et al., 2021; Nagi et al., 2024).

The higher mediation observed in this study may reflect the structured collaborative practices implemented in the participating universities, ensuring equitable participation. SE also acted as a significant mediator, indicating that students' confidence in their academic abilities enhances the effect of CL on CT. This aligns with Social Cognitive Theory, which links self-efficacy to motivation, persistence, and engagement in cognitive tasks (Hussain et al., 2023). Previous research has similarly shown that students with higher SE are more likely to engage in critical thinking and persist with challenging academic problems (Awad, 2024; Almeer et al., 2024; Nagi, 2024). In the

Pakistani context, where traditional education can impede student confidence, SE appears particularly instrumental in enabling learners to fully benefit from collaborative pedagogies. The total effect of CL on CT (β = 0.396) increased with the inclusion of the mediators, highlighting the substantial contribution of indirect pathways through PI (β = 0.130) and SE (β = 0.157). These findings emphasize that cognitive and motivational processes function together to enhance critical thinking, providing a more nuanced understanding than studies examining only direct effects (Abdulrahim et al., 2024; Aldabousi, 2025). These results also reflect contextual factors in Pakistan's higher education system, where a shift toward student-centered learning is underway but traditional lecture-based methods remain prevalent (Awad, 2024, Ramadan et al., 2025; Aldabousi, 2022).

The positive outcomes observed may be supported by specific institutional interventions promoting systematic group work, feedback, and reflective activities, consistent with Nagi and Nigam (2023) on active knowledge-building and continuous social-motivational reinforcement. The findings validate the complementary nature of the theoretical framework: Social Constructivism explains knowledge co-construction through PI, Social Cognitive Theory highlights the role of SE in sustaining engagement and cognitive persistence, and Collaborative Learning Theory provides the structured pedagogical strategies to operationalize these processes. While the results are largely consistent with international research, they also highlight context-specific patterns. For example, structured CL appears to mitigate cultural communication variations observed in other studies (Wahid & Awad, 2025), and SE assumes added importance in hierarchical educational environments where student autonomy is typically limited. Overall, the study contributes theoretically by integrating multiple frameworks and empirically by demonstrating practical strategies to enhance CT in higher education systems of developing countries.

5.1 Theoretical Implications

This study integrates Social Constructivism, Social Cognitive, and Collaborative Learning theories to show that critical thinking develops through the combined influence of social interaction, motivational processes, and structured pedagogical strategies. It provides empirical evidence for the mediating roles of peer interaction (PI) and self-efficacy (SE) in translating collaborative learning (CL) into critical thinking (CT), clarifying the mechanisms behind these effects. The research extends the application of these theories to the context of Pakistani higher education and validates a structural model of direct and indirect relationships, offering a framework for future cross-cultural and academic investigations.

5.2 Practical Implications

For instructors, the study highlights the value of structured collaborative learning (CL) activities, including group projects, peer-led discussions, and problem-based exercises, to enhance student engagement and critical thinking (CT) through peer interaction (PI) and self-efficacy (SE). Strategies that build student confidence and autonomy, such as scaffolding complex tasks,

providing constructive feedback, and encouraging self-reflection, are essential. Monitoring group dynamics ensures fair participation and maximizes the cognitive benefits of CL. For administrators, faculty training programs are recommended to develop skills in managing collaborative activities and facilitating effective peer interactions. Systematic adoption of CL methods across courses, particularly in settings dominated by lecture-based pedagogy, can improve learning outcomes. Interventions that combine pedagogical and psychological support further strengthen PI and SE, enhancing student CT development. For policymakers and curriculum developers, higher education policies should incorporate mandatory CL units, teamwork workshops, and assessments that recognize CT skills. Aligning curricula with 21st-century competencies, emphasizing analytical reasoning, problem-solving, and collaboration, can better prepare students for professional challenges. Institutional frameworks providing coordinated pedagogical and psychological support can further improve student learning outcomes and the overall quality of education.

5.3 Limitations

This study has several limitations that provide context for interpreting the findings and inform future research. First, the cross-sectional design limits causal inference, suggesting a need for longitudinal or experimental studies to explore temporal dynamics in the impact of collaborative learning (CL) on critical thinking (CT) (Awad, 2024; Aldabousi, 2025; Alahmari & Awad, 2025; Hussain et al., 2025). Second, the sample was restricted to students from a few universities in Karachi, Pakistan, limiting generalizability to other regions, institutions, or cultural contexts. Third, data were self-reported, which may introduce biases such as social desirability or overestimation of engagement and self-efficacy (SE), despite low common method bias. Fourth, the measurement of CT showed an AVE below 0.50, indicating potential limitations in capturing the full construct. Fifth, the study focused only on peer interaction (PI) and SE as mediators, excluding other potential mediators or moderators such as motivation, cognitive load, personality traits, or cultural factors. Sixth, the study did not differentiate among specific CL strategies (e.g., problem-based learning, peer tutoring, or case-based discussions), which may vary in effectiveness. Lastly, the research relied solely on quantitative data, limiting insight into students' perceptions and experiences.

5.4 Future Research Directions

Future studies can address these limitations to enhance theoretical and practical understanding Conduct longitudinal or experimental studies to establish causal relationships and temporal effects of CL on CT. Expand sampling to include multiple institutions, regions, and countries to test the generalizability of the findings and explore cultural influences. Incorporate objective measures, such as instructor assessments, performance evaluations, or observational data, to complement self-reported responses. Investigate additional mediators or moderators, including motivation, cognitive load, personality traits, or cultural variables, to understand the mechanisms influencing CT. Compare different CL strategies to determine which approaches most effectively enhance PI, SE, and CT across diverse educational settings. Employ mixed-method designs,

including interviews, focus groups, or student reflections, to gain richer insights into the processes underlying CL and CT.

6. Conclusion

The present study demonstrates that collaborative learning (CL) positively influences students' critical thinking (CT), with peer interaction (PI) and self-efficacy (SE) serving as significant mediators. Integrating Social Constructivism, Social Cognitive, and Collaborative Learning theories, the findings highlight that CT development is multidimensional, shaped by social, motivational, and pedagogical factors. Structured CL not only directly enhances CT but also indirectly strengthens cognitive outcomes by fostering meaningful PI and building students' confidence in their academic abilities. These results underscore the importance of systematically incorporating CL, promoting equitable PI, and supporting SE in higher education curricula. Despite limitations such as the cross-sectional design and reliance on self-reported data, the study provides valuable theoretical and practical insights into the mechanisms through which CL can cultivate higher-order cognitive skills in the Pakistani context. Overall, this research contributes to understanding how integrated pedagogical, social, and motivational strategies can effectively develop critical thinkers in higher education.

Declarations

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None.

Competing Interests
None.

Ethical Approval
This study was granted an exemption from requiring ethics approval as it does not involve the collection of sensitive personal data. The research is based on survey and interview methods, utilising primary data exclusively from the undergraduate art students. As such, it adheres to institutional guidelines that classify this type of study as low-risk and not subject to formal ethics approval.

Author's Contribution
Author[1]: Conceptualization, Investigation, Software, Data curation, Formal analysis, Visualization, Writing – original draft

Data availability
None.

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