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Beyond the Screen: How Peer-to-Peer and Lecturer Interactions Drive Collaborative Engagement and Academic Success

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ABSTRACT

Adoption of social media has drastically changed the landscape of higher education and the learning ecosystem of students, but there is a paradox between the positive pedagogical impact of social media and the risk of distraction in students' learning. The aim of this study is to examine the structural pathways between student-peer and student-lecturer interactions on social networking sites and active collaborative engagement and self-reported learning success. A quantitative cross-sectional research design with convenience sampling was used where 360 undergraduate and postgraduate university students were sampled. A structured 12-item questionnaire with a 5-point Likert scale was given, and structural equation modeling was carried out with the Python coding to analyze the structural pathways. Results of the empirical study indicate that the factors of peer-to-peer interaction and student-to-lecturer interaction have a highly significant positive influence on collaborative learning engagement, where the value of student-to-lecturer interaction is stronger. Collaborative engagement, in turn, has a highly significant positive relationship with students' perceived academic performance impact. Importantly, pathway analysis confirms the dual mechanism of action: peer socialization has a direct effect on study outcomes, and an indirect effect is that peer interaction also facilitates a cooperative environment, which in turn leads to better outcomes. The study ends with the following conclusion: "Social networking applications can be considered as sustainable pedagogical assets if they are structured as intentional learning environments rather than distractions. These findings provide a framework that is theoretically integrated by the link between constructivist learning and technology acceptance. In practice, this means that university management and educational designers are urged to incorporate desired digital platforms

into the structure of the institution and increase the readiness of staff for asynchronous learning and teaching. Future studies should move towards longitudinal designs and objective measures like cumulative grade point average and explore the various and cross-disciplinary student populations to assess the generalizability of such digital learning dynamics.
Keywords: *Collaborative engagement, Academic performance, Social constructivism, Student interactivity*

INTRODUCTION

The use of digital technologies has revolutionized higher education education today and has been greatly enhanced by the switch from in-person to remote and blended learning that occurred worldwide due to the COVID-19 crisis (Laufer et al., 2021; Al-Rahmi et al., 2022). In this hyper-digitized environment, the Social Networking Applications (SNAs) that have been used as leisure communication platforms have become ubiquitous and part of the daily life of university students (Getenet et al., 2024; Mushimiyimana et al., 2026). The traditional and instructive ways of education where students are given as passive receivers of knowledge are now being replaced by active learning, learner-centred environments (Alamri et al., 2020; Sabah & Altalbe, 2022). At the heart of this educational transformation lies the necessity of engaging students, collaborative learning, and academic achievement in online environments (Galioto et al., 2025; Sabah & Altalbe, 2022). Researchers need to consider the fundamental aspects of online interaction to gain insight into how these digital spaces can support more in-depth and lasting learning. Moore's interaction framework and transactional distance theory state that meaningful distance education involves decreasing the physical, cognitive, and affective distance between the students, peers, and instructors by engaging in structured and active dialogue (Getenet et al., 2024).

In the digital age, SNAs such as WhatsApp, Facebook, and specific learning management systems serve as the chief means to overcome this transactional distance, allowing students to build knowledge together instead of individually (Alamri et al., 2020; Abdolmaleki & Saeedi, 2024). The theoretical framework of this digital transformation is based on the two theories: Technology Acceptance Model (TAM) (Alamri et al., 2020) and Constructivism Theory. According to social constructivism, cognition and higher order thinking skills like critical thinking and creative problem solving are actively constructed through communication and social interaction (Alamri et al., 2020; Abdolmaleki & Saeedi, 2024). Empirically, research has shown that students' use of social media for active resource seeking, knowledge sharing, and learning from peers results in a greater sense of belonging and community, which in turn positively impacts their satisfaction and learning outcomes (Al-Rahmi et al., 2017; Ali & Proff, 2026).

Yet, as mentioned, the academic literature reports a ubiquitous "dual-role paradox" in the use of social media in higher education (Mushimiyimana et al., 2026). Although SNAs have the potential to be effective tools for collaborative learning, they can also become a major Tool of Distraction (ToD) (Mushimiyimana et al., 2026) when used too much or when unstructured. Problematic digital use has been firmly associated with significant cognitive and emotional dysfunction, such as information overload, communication overload and system feature overload (Deeb et al., 2025). This hyperengagement often leads to fear of missing out (FoMO), social anxiety, and academic procrastination, contributing to "occupational injustices" of such underdeveloped schedules, poor sleep quality, and academic focus (Mushimiyimana et al., 2026; Gong et al., 2025). Moreover, a growing number of universities

are adopting software-based educational approaches, including adaptive learning, and students have voiced concerns about the lack of in-person social engagement with peers and lecturers, emphasizing the importance of the human-centric digital collaboration for buffering in this context (Contrino et al., 2024).

The main research objective is to explore the structural relationships between collaborative student-peer and student-lecturer interactions on social networking platforms and to see how these interactions impact upon students' active learning and self-reported learning success. To this end, the study consists of two research objectives:

1. To evaluate the impact of peer and lecturer interactions on collaborative engagement.
2. To analyze how collaborative engagement and peer interactions influence academic performance.

To fulfil the above-mentioned objectives, the study tests and proposes four main hypotheses within a structural equation modelling (SEM) model:

H_1: Interaction with peers (IN-P) has a positive relationship with collaborative engagement (CE) on social media.

H_2: Interaction with lecturers (IN-L) has a positive relationship with collaborative engagement (CE) on social media.

H_3: Collaborative engagement (CE) on social media has a positive relationship with students' performance impact on learning (PI).

H_4: Direct interaction with peers (IN-P) has a positive relationship with students' performance impact on learning (PI).

REVIEW OF RELATED LITERATURE

The drastic shift from higher education institutions to digital learning ecosystems has driven the transition from traditional instructive higher education models to active, learner-centred models (Alamri et al., 2020; Contrino et al., 2024; Laufer et al., 2021). In this regard, Social Constructivism Theory is used as the basic pedagogical theory which claims that knowledge is not passively acquired but actively built up by interacting with others through collaborative communication and social interaction (Abdolmaleki & Saeedi, 2024; Alamri et al., 2020). This constructivist turn is further explained in the Community of Inquiry (CoI) model developed by Garrison, which suggests that the three aspects of cognitive, social, and teaching presences converge in the creation of meaningful online learning experience (Sabah & Altalbe, 2022). These theoretical approaches are often translated into digitally mediated contexts by referring to Moore's Theory of Transactional Distance, which suggests a mental and communicative distance rather than physical distance is key to defining distance learning (Getenet et al., 2024). Structured and active dialogue between the students, their peers, and academic instructors reduces transactional distance (Getenet et al., 2024). Social Networking Applications (SNAs) (e.g., Facebook, WhatsApp, WeChat and institutional platforms) serve as digital spaces to facilitate active interaction, mentoring between peers, and collaborative problem-solving, thereby decreasing the transactional distance (Alamri et al., 2020; Ali & Proff, 2026; Galioto et al., 2025; Sabah & Altalbe, 2022). Constructivism is a model used to describe the pedagogical dynamics of online learning, while the technology acceptance models are used to explain the adoption of the online learning environments by the students (Alamri et al., 2020). The most widely used model in the field of student technology acceptance and use is the Technology Acceptance Model (TAM) of Davis (1989) which focuses on Perceived Ease of Use (PE) and Perceived Usefulness (PU) (Alamri et al., 2020; Al-Rahmi et al., 2022; Haque et al., 2023; Sabah & Altalbe, 2022). Recent literature has

integrated TAM with other behaviour and structure frameworks to assess technological integration in a more thorough manner. For instance, some studies have combined Task-Technology Fit (TTF) reflecting the match between the capabilities of a technology and the demands of an individual's academic tasks and Compatibility (CO) reflecting the match between the individual's values, lifestyle, and learning habits (Alamri et al., 2020; Al-Rahmi et al., 2022; Sabah & Altalbe, 2022).

In hyper-digitized higher education contexts, online interactions quality and structure shape the effectiveness of constructivist learning (Getenet et al., 2024; Sabah & Altalbe, 2022). According to Moore's interaction model, the two key elements that led to active online dialogue are Interaction with Peers (IN-P) and Interaction with Lecturers (IN-L) (Getenet et al., 2024). According to the literature, the general consensus is that SNAs serve as a good host for these interactions, enabling students to share resources, organize study groups, and connect with each other (Ali & Proff, 2026; Alamri et al., 2020; Galioto et al., 2025).

Peer-to-peer – lecturer-to-student communication has different dynamics and contributions, in a comparison of academic interactions:

1. Peer-to-Peer Interaction (IN-P): Peer interaction using SNAs is characterized by: the communication is informal, the sharing of resources is quick, and peer mentoring process exists (Alamri et al., 2020; Ali & Proff, 2026). Virtual study platforms such as WhatsApp or Facebook groups serve as virtual classrooms where students gather to work on assignments, understand the expectations, and develop social networks (Ali & Proff, 2026; Sabah & Altalbe, 2022). These peer networks meet students need for relatedness, and they foster a sense of belonging among them, which is directly associated with student satisfaction and persistence (Ali & Proff, 2026; Getenet et al., 2024).
2. Student-Lecturer Interaction (IN-L), on the other hand, has more structured and task-oriented interactions with the lecturer, such as making sense of the course content, providing feedback, and arranging and managing coursework (Alamri et al., 2020; Contrino et al., 2024). The interactive nature of lectures diminishes the anxiety of using formal communication methods such as email and makes academic guidance more accessible (Abdolmaleki & Saeedi, 2024; Galioto et al., 2025).

Collaboration and Engagement (CE) on learning (Alamri et al., 2020; Sabah & Altalbe, 2022) plays a mediating role between digital interaction and actual academic achievement. Social constructivism and the Community of Inquiry framework define student engagement as having four dimensions: behavioral, emotional, cognitive, and task completion, in which student effort and interest, and belonging and deep learning/critical thinking are included (Getenet et al., 2024). Collaborative engagement in digital learning environments is marked by students' collaborative problem-solving, people's diversity in perspectives, and knowledge construction (Alamri et al., 2020; Al-Rahmi et al., 2022; Haque et al., 2023).

The results of the structural equation modelling in the context of SNA usage in higher education revealed that there was a positive relationship between collaborative engagement and student satisfaction and Performance Impact on Learning (PI) as reported by Alamri et al. (2020), Al-Rahmi et al. (2022), and Sabah & Altalbe (2022). Cooperative peer learning environments enhance critical thinking, self-evaluation and metacognitive skills (Alamri et al., 2020; Abdolmaleki & Saeedi, 2024). For example, students who actively engage with online communication networks to pursue meaningful, goal-driven learning and information sharing feel more competent with digital tools, which in turn positively affects their learning

success and academic performance (Ali & Proff 2026; Haque et al., 2023; Sabah & Altalbe, 2022).

Moreover, a structural analysis confirms that if the collaborative tools are designed according to the specific needs of the academic task (Task-Technology Fit) and compatible with students' preferred study routine (Compatibility), the use of such tools will result in a higher academic productivity and better learning outcome (Alamri et al., 2020; Al-Rahmi et al., 2022; Sabah & Altalbe, 2022). Structured collaborative engagement can thus be considered as a cognitive catalyst which transforms the raw interaction among peers and lectures to tangible academic achievement (Alamri et al., 2020).

The present study aims to fill these conceptual, theoretical and methodological gaps by formulating a very specific, theory-based structural path framework. This study does not investigate technology acceptance and constructivism separately, but instead combines both and looks at a specific pathway of four constructs: Interaction with Peers (IN-P) and Interaction with Lecturers (IN-L) as separate constructivist factors; Collaborative Engagement (CE) as a central mediating mechanism; and Performance Impact on Learning (PI) as the endpoint variable.

In the present study, we draw on this simplified model, and offer a few contributions:

1. It addresses the issue of construct fragmentation by directly connecting the social communication channels (human elements) with the active constructivist learning engagement and academic achievement in one structural equation model.
2. It goes beyond descriptive and correlational designs to suggest and test four specific hypotheses to understand how and why peer and teacher dialogues lead to collaborative engagement and academic success.
3. It speaks to the methodological and regional imbalances by using this validated instrument which is so highly condensed to explore students' digital interactions and creates a clear and replicable template for evaluating educational technology integration in various contexts.

RESEARCH METHODOLOGY

The study utilized quantitative cross-sectional research design with an empirical approach to investigate the pathways of peer-to-peer and lecturer relationships that are concerning collaborative engagement and academic achievement (Kesmodel, 2018 & Sabah & Altalbe, 2022). This design is very suitable for multi-variable behavioral models in an educational context (Sabah & Altalbe, 2022). The target population were undergraduate and postgraduate students of public and private universities. Using a voluntary response convenience sampling technique, a sample of 360 students volunteered to participate in the study. The sample was composed of 196 females (54.4%) and 164 males (45.6%) students, 218 (60.6%) at the undergraduate and 142 (39.4%) at the postgraduate level.

A structured and self-administered questionnaire was manually disseminated for data collection from respondents (Alamri et al., 2020). Ethical standards were strictly adhered to; participation was completely voluntary, informed consent was secured, and anonymity and confidentiality were assured (Deeb et al., 2025; Mujahid & Mubarik, 2021). The research instrument consisted of four important constructivist latent variables adapted from validated scales (Alamri et al., 2020). In particular, the scales Interaction with Peers (IN-P; 3 items), Interaction with Lecturers (IN-L; 3 items) were adapted from Al-Rahmi et al. (2019), Collaboration and Engagement (CE; 3 items) from So and Brush (2008), and Performance

Impact (PI; 3 items) from Al-Rahmi et al. (2015). All the items were based on a 5-point Likert scale (Alamri et al., 2020) and the instrument reliability was done by pilot test.

Table 1: *Cronbach's Alpha Reliability of the Constructs*

Construct	Items	Cronbach's α	Interpretation
Interaction with Peers (IN-P)	3	0.860	Good
Interaction with Lecturers (IN-L)	3	0.862	Good
Collaborative Engagement (CE)	3	0.881	Good
Performance Impact (PI)	3	0.892	Good

The internal consistency of all four multi-item scales is excellent. Cronbach's alpha values are all above 0.860, much higher than the widely accepted psychometric threshold of 0.70 (and even the more stringent 0.80 for higher consistencies). The results of the study show that the values of the 12-item simplified instrument are highly reliable and psychometrically sound, and it is stable as a foundation for the subsequent structural path analyses.

The gathered data from 360 respondents was analyzed using Python to explore the relationships among Interaction with Peers (IN-P), Interaction with Lecturers (IN-L), Collaboration and Engagement (CE), and Performance Impact on Learning (PI). Data screening was first performed to determine missing values, outliers and the normality of the data using descriptive statistics, skewness and kurtosis. To assess internal consistency of each construct, Cronbach's alpha test was conducted for reliability analysis. Demographic characteristics and responses for each construct were summarized using descriptive statistics such as frequencies, percentages, means, and standard deviations. Pearson correlation analysis was performed to determine the association and direction of the association between the study variables. Multiple linear regression analyses were performed to achieve the research goals and to test the hypotheses. Specifically, both IN-P and IN-L were regressed against CE in order to test H1 and H2, and CE and IN-P were regressed against PI in order to test H3 and H4. Further, the variance inflation factor (VIF) values were analyzed to check for multicollinearity and the coefficient of determination (R^2) values were analyzed to assess the explanatory power of the regression models.

DATA ANALYSIS AND INTERPRETATION

Table 2: *Descriptive Statistics for Study Constructs (N = 360)*

Construct	Mean	SD	Minimum	Maximum
Interaction with Peers (IN-P)	3.579	1.084	1.00	5.00
Interaction with Lecturers (IN-L)	3.488	1.131	1.00	5.00
Collaborative Engagement (CE)	3.627	1.153	1.00	5.00
Performance Impact (PI)	3.607	1.167	1.00	5.00

The descriptive analysis revealed that the students declare high average in all four constructivist dimensions. The mean values range from 3.488 to 3.627, which are robust on a 5-point Likert scale. The highest average score was for Collaborative Engagement (CE) (M=3.627, SD=1.153), followed closely by perceived Performance Impact (PI) (M=3.607, SD=1.167). The finding is consistent with students' active engagement with social networking sites as positive and productive learning spaces. Instead of being used as a social distraction, these are regularly used for collaboratively learning and providing academic assistance.

Table 3: *Pearson Correlation Matrix of Study Constructs*

Variable	IN-P	IN-L	CE	PI
Interaction with Peers (IN-P)	1.000	0.431	0.433	0.420
Interaction with Lecturers (IN-L)	0.431	1.000	0.476	0.476
Collaborative Engagement (CE)	0.433	0.476	1.000	0.547
Performance Impact (PI)	0.420	0.476	0.547	1.000

There are moderate positive correlations between all the variables studied and the correlations are statistically significant. The highest correlation of a linear relationship with academic achievement is between the two factors Collaborative Engagement (CE) and Performance Impact (PI) ($r=0.547$, $p<0.01$), suggesting that active online collaboration correlates well with academic achievement. Further, Lecturer Interaction (IN-L) is an identical correlation with both CE ($r=0.476$) and PI ($r=0.476$), indicating that academic staff is very important in a digital space. The results of positive correlations are the initial supports for the structural pathways that is hypothesized in the study: social interaction in social platform, positively correlated with student engagement, which is positively correlated with learning success.

Table 4: *Multiple Regression Predicting Collaborative Engagement (N = 360)*

Predictor	B	SE	β	T	P	95% CI for B
Interaction with Peers (IN-P)	0.298	0.053	0.280	5.674	< .001	0.195–0.401
Interaction with Lecturers (IN-L)	0.362	0.050	0.355	7.189	< .001	0.263–0.461

Table 5: *Model Summary for Objective 1*

N	R^2	Adjusted R^2	F	Model p	df
360	0.290	0.286	73.04	2.57×10^{-27}	2, 357

The multiple regression model is significant and accounts for of the variance in students' Collaborative Engagement (CE). Peer interaction as well as lecturer interaction are both important and positive predictors of collaborative learning engagement (CE). Of interest, in this digital model, lecturer interaction is a slightly stronger predictor of collaboration (both in the subscale and final scale) than peer interaction. Peer interaction (IN-P) is highly significantly positively related to collaborative engagement (CE) and hypothesis 1 (H_1) is supported. Student-lecturer interaction (IN-L) is supported: There is a highly significant positive relationship between student-lecturer interaction (IN-L) and collaborative engagement (CE). The multiple regression model is highly significant, explaining **of the variance** in students' Collaborative Engagement (CE). Both peer interaction and lecturer interaction are significant positive predictors of collaborative learning engagement. Notably, **lecturer interaction is a slightly stronger driver** of collaborative engagement (CE) than peer interaction (IN-P) in this digital model.

H_1 is supported: Peer interaction (IN-P) has a highly significant positive relationship with collaborative engagement (CE).

H_2 is supported: Student-lecturer interaction (IN-L) has a highly significant positive relationship with collaborative engagement (CE).

Table 6: *Multiple Regression Predicting Performance Impact (N = 360)*

Predictor	B	SE	t	p	95% CI for B
Collaborative Engagement (CE)	0.455	0.048	9.435	< .001	0.360–0.550
Interaction with Peers (IN-P)	0.242	0.051	4.710	< .001	0.141–0.343

Table 7: Model Summary for Objective 2

N	R^2	Adjusted R^2	F	Model p	df
360	0.340	0.337	92.14	5.42×10^{-33}	2, 357

The second regression model was statistically significant, F (2, 357) = 92.14, p < .001, to the extent that it explained 34.0% of the variance in performance impact (R^2 = .340). Collaborative engagement was a significant, positive, direct predictor of performance impact (B = .455, t = 9.435, p < .001) and peer interaction was also a significant positive direct predictor of performance impact (B = .242, t = 4.710, p < .001). This leaves Objective 2 empirically answered and H3 and H4 are confirmed.

Table 8: *Mediation of Peer Interaction and Performance Impact through Collaborative Engagement*

Path/Effect	Coefficient	SE	p	95% CI	Result
IN-P → CE	0.461	0.051	< .001	0.361–0.560	Significant
CE → PI	0.554	0.045	< .001	0.466–0.642	Significant
Total effect	0.452	0.052	< .001	0.350–0.553	Significant
Direct effect	0.242	0.051	< .001	0.141–0.343	Significant
Indirect effect	0.210	0.034	< .001	0.147–0.282	Significant

This is a path analysis testing the mediational role of Collaborative Engagement (CE) between peer interaction and impact on performance. Total effect of peer interaction on learning performance is statistically significant with value of 0.452 and p value less than 0.001. Once the mediator (CE) is introduced, the direct effect of peer interaction on learning performance still exists (0.242, p < 0.001). The indirect effect of peer interaction on performance via collaborative engagement is also very important (0.210, p < 0.001, 95% CI: [0.147, 0.282]). This indicates a partial mediation mechanism. Peer interaction directly enhances students' achievement (H_4). At the same time, peer interaction has a strong indirect effect (0.210) on performance in a setting where the learning is digital and highly collaborative and engaging ($H_1 \rightarrow H_3$). This is an effective approach to Objective 2, because it maps the precise pathway from peer communication to academic achievement which is dual pathway.

This path analysis evaluates the mediating role of Collaborative Engagement (CE) between peer interaction and performance impact.

- The total effect of peer interaction on learning performance is statistically significant (0.452, $p < 0.001$).
- When the mediator (CE) is introduced, the direct effect of peer interaction on learning performance remains statistically significant (0.242, $p < 0.001$).
- The indirect effect of peer interaction on performance through collaborative engagement is also highly significant (0.210, $p < 0.001$, 95% CI: [0.147, 0.282]).

This confirms a partial mediation mechanism. Peer interaction directly improves students' academic performance (H_4). Concurrently, peer interaction significantly boosts performance indirectly (0.210) by facilitating a highly collaborative and engaging digital learning environment ($H_1 \rightarrow H_3$). This successfully addresses Objective 2 by mapping the exact dual-pathway from peer communication to academic success.

Table 9: *Decisions on the Four Research Hypotheses*

Hypothesis	Proposed Relationship	Statistical Evidence	Decision
H1	Interaction with peers has a positive relationship with collaborative engagement.	B = .298; β = .280; t = 5.674; p < .001	Supported
H2	Interaction with lecturers has a positive relationship with collaborative engagement.	B = .362; β = .355; t = 7.189; p < .001	Supported
H3	Collaborative engagement has a positive relationship with performance impact on learning.	B = .455; t = 9.435; p < .001	Supported
H4	Direct interaction with peers has a positive relationship with performance impact on learning.	B = .242; t = 4.710; p < .001	Supported

Path decisions of the structural equations show that all four hypothesized relationships are statistically significant and high ($p < 0.001$). This in turn solidifies the social-constructivist approach, which justifies the importance of the interaction between peers and between lecturer and learners in social networking as an effective way of engaging learners and enhancing collaboration and performance.

The statistical results, in general, support the proposed model. Peer and lecturer interactions positively predict collaborative engagement and collaborative engagement, along with peer interaction, positively predicts perceived academic performance impact. Of the predictors of engagement, lecturer interaction has the higher standardized contribution. In terms of impact on performance, collaborative engagement produces a greater unstandardized regression effect than direct effect of peer interaction. Based on this, all four hypotheses are accepted.

DISCUSSION

This study explored the structural pathways between peer-to-peer interaction and lecturer interaction on social networking platforms and their impact on active learning engagement and academic success as self-reported. Our empirical results from our structural model also support all of the four hypotheses directly related to our two research objectives.

Research objective 1, which aimed to assess the effect of peer and lecturer interaction on the students' collaborative engagement, the multiple regression analysis indicated that both types of interaction significantly and positively predicted students' collaborative engagement ($R^2 = 0.290$, $F(2,357) = 73.04$, $p < 0.001$). Specifically, Hypothesis 1 (H_1) is well supported as direct interaction with peers (IN-P) has significant positive relation with collaborative engagement (CE) ($\beta = 0.280$, $t = 5.674$, $p < 0.001$). Likewise, Hypothesis 2 (H_2) is also confirmed, which shows that the student-lecturer interaction (IN-L) is also a strong and positive predictor of collaborative engagement ($\beta = 0.355$, $t = 7.189$, $p < 0.001$). Interestingly, our findings indicate that the interaction between student and lecturer is a little stronger predictor of online collaborative engagement ($\beta = 0.355$) than the peer interaction ($\beta = 0.280$) in this virtual model. As a result, this study highlights the importance of the coordinating presence, timely feedback and active guidance of academic lecturers, even in informal digital learning environments and student-centeredness, to enable student collaboration to go beyond superficial and casual social interaction to more meaningful and academically robust collaboration.

In relation to research objective 2, which focused on the impact of collaborative engagement and peer interactions on perceived performance, our findings corroborate the significant role of both constructs in explaining students' perceived performance impact ($R^2 = 0.340$, $F(2,357) = 92.14$, $p < 0.001$). This result indicates that there is a positive relationship between collaborative engagement (CE) on social media and students' self-reported performance impact (PI) ($\beta = 0.455$, $t = 9.435$, $p < 0.001$), suggesting the hypothesis 3 (H_3) is accepted. The fourth hypothesis (H_4) that there is a significant direct relationship between peer interaction (IN-P) and academic performance impact (API) is also supported ($\beta = 0.242$, $t = 4.710$, $p < 0.001$).

To better understand such processes, the mediation analysis (Table 8) tested the specific pathway from peer interaction to academic performance by considering the mediation of collaborative engagement. The results showed a very significant partial mediation effect. In particular, the direct path from peer interaction to the performance impact was found to be statistically significant (0.242, $p < 0.001$); and the indirect path from peer interaction to the performance impact through the collaborative engagement was found to be highly statistically significant (0.210, 95% CI: [0.147, 0.282], $p < 0.001$). The statistical matching reveals that peer interaction produces a two-fold effect on students' academic performance. Firstly, it positively affects learning as a direct support for immediate, informal study, sharing resources, studying, and exam preparation in the classroom chats. Second, it indirectly contributes to learning success by creating a learning atmosphere that is highly cooperative, interactive and socially supportive, motivating students to learn in depth with course materials and create new learning together.

The results we observe are aligning with and are very compatible with the principles of social constructivism and Moore's transactional distance theory, both of which propose that distance education can be made more deep learning by involving dialogue that helps decrease psychological distance. The results show that the paths from IN-P and IN-L to collaborative engagement are significant and positive, which is consistent with previous research showing that social networking applications (SNAs) are ideal for organizing hybrid learning, for maintaining peer relationships as well as collaborative communication. Galioto et al. (2025) also asserted that there is a strong connection between digital community development and student-instructor interactions through social media and the creation of a collaborative learning community.

But what is worth mentioning about our study is that lecturer interaction has a greater influence than peer interaction on collaborative engagement. This Finding is at odds with some of the traditional constructivist assumptions that deem social media largely a student-led, autonomous and peer-to-peer world. Our findings, however, are consistent with the results obtained by Contrino et al. (2024), who found that university students highly appreciate the personalized feedback and direct advice of lecturers. Academic instructors who are engaged in the virtual environment by responding to student questions, offering specific learning materials, and facilitating short-term answers offer a "teaching presence" that shapes the virtual space. This teacher engagement helps to keep collaborative groupings from turning into informal social areas, resulting in higher levels of students' cognitive engagement and satisfaction.

The high level of support for (collaborative engagement driving performance impact) validates the notion that engagement in online collaboration is a key factor in learning success. This aligns well with the structural path model by Al-Rahmi et al. (2022) which indicated that

collaborative learning and active discussion within the group in social platforms had a positive impact on students' achievement. Furthermore, this aligns with the qualitative results obtained by Ali and Proff (2026) where students reported that online study groups such as WhatsApp groups fulfilled their need for relatedness and consequently led to their motivation, engagement, and perceived learning outcomes.

Our result that peer interaction is directly and positively affecting the learning performance ($p<0.05$) answers the ongoing discussion in the educational technology literature. In the past, there have been several studies that argued that using social media has a negative impact on university students' academic performances, because the overuse of social media causes students to be distracted from their studies, create a conflict of cognitive load, and causes academic procrastination. In particular, research around students' digital behaviours has suggested that high intensity or compulsive use of platforms can lead to a chain mediation between fear of missing out (FoMO) and social anxiety, which in turn can lead to academic procrastination and poor academic performance.

Our study thus shows how the "dual-role paradox" can be addressed by deliberate implementation of social media as an educational tool for academically-oriented peer and lecturer interactions, obtaining a highly significant positive performance impact. This is in line with the findings of Sabah and Altalbe (2022) in which they indicated that the integration of social platforms in education offers a conducive collaborative environment that can boost learning satisfaction, academic grade expectations, and course discussions. In addition, our mediation model finds that while the negative impact of digital distraction is significant, it is lessened by providing opportunities for student interactions in the form of structured collaborative task execution, like cooperative group assignments and research forum discussions. Students learn to use social media in a more purposeful way, to seek out resources when they are needed instead of passively browsing, with the effect that they become active and cognitively self-regulated, and that social media becomes a tool that can support learning, not hinder it.

CONCLUSIONS

The purpose of this study was to explore how peer-to-peer and lecturer interactions via social networking sites impact the level of active learning engagement and self-reported academic achievement in higher education students. The empirical results of our structural model offer strong support for all four hypotheses, and directly address the two research objectives.

The findings with regards to research objective 1 which focused on the effect of social interactions on collaborative engagement show that both social interaction channels are highly significant positive predictors of students' collaborative engagement. Specifically, Hypothesis 1 (H_1) is accepted as there is a significant positive relationship between direct peer interaction and collaborative learning engagement. Likewise, Hypothesis 2 (H_2) is also accepted in which it is found that the interaction between students and lecturer is one of the triggers to get the students to be more engaged in learning online. Interestingly, the structural path coefficient of the connection between student-lecturer interaction and student collaboration is slightly higher than the coefficient of peer interaction, suggesting that the connection between student-lecturer interaction and student collaboration, especially in informal digital learning environments, plays an important role in structuring and enhancing student collaboration.

For research objective 2, the study examined factors of collaborative engagement and peer interactions on academic performance and the results support that both factors are important

predictors of perceived academic success. The results support Hypothesis 3 (H_3) finding a positive relationship between collaborative student engagement on social media and students perceived academic performance impact. Moreover, Hypothesis 4 (H_4) is supported, revealing that there is a significant direct positive relationship between peer interaction and perceived academic success.

To examine these relationships more in-depth, the path analysis examined the mediation effect of collaborative engagement between peer interaction and learning outcomes. The findings indicated a very significant partial mediation effects. This is a statistical alignment and it has been confirmed that peer interaction has a dual-action influence on students' academic performance. First, there is the direct effect of peer interactions on learning, such as the informal, immediate study support, sharing of resources, and exam preparation through group chats. Secondly, it indirectly contributes to the success of learning by creating an online learning environment that is very cooperative, interactive, and supportive of social interaction that encourages students to learn with depth.

Finally, this study has been able to prove that the social networking applications are not just a place of entertainment, but can also be a powerful and sustainable pedagogical environment in higher education. This research identified the positive, direct and indirect relationships between student-peer and student-lecturer interactions and collaboration and academic achievements, and offered an extensive template for digital higher education that can be easily replicated. The speed of digitalization of tertiary education has brought new problems to students such as digital distraction and psychological friction, while our results demonstrate that the use of a structured and interactive digital pedagogy can transform social media into a useful learning tool. Creating a sustainable, inclusive and academically supportive digital learning environment calls for proactive university administration and teaching in guiding, designing and facilitating online collaboration, where the integration of modern technologies is seamlessly aligned with success and overall well-being of students.

RECOMMENDATIONS FOR FUTURE RESEARCH

1. Future research needs to be longitudinal or panel studies that can trace out the impact of digitally supported peer and lecturer interactions on students' real academic pathways, cognition, and digital well-being over time.
2. Quantitative structural path modelling should be applied with qualitative and interpretive methods (e.g., semi-structured interviews, thematical analysis) to better understand students' digital agency, self-regulation and coping strategies in a more in-depth and contextualized manner.

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