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RESEARCH ARTICLE

Online Collaborative Learning Behaviours in Facebook Group Discussions: A Content Analysis of Undergraduate Students

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ABSTRACT

Online collaborative learning (OCL) enables students to construct knowledge through sustained interaction in digital environments, yet evidence of how such collaboration is manifested in observable discussion behaviours remains limited. This study investigated undergraduate students' online collaborative learning behaviours in Facebook group discussions. A single-case study design with quantitative content analysis was employed involving 42 undergraduate students who participated in five structured collaborative learning activities over 14 weeks. A total of 2,455 discussion comments were coded using an adapted online collaborative learning behaviours coding scheme. The findings showed that social behaviours were the most prevalent, accounting for 50.1% of all coded comments, followed by integrated behaviours (36.3%) and cognitive behaviours (13.6%). Group dynamics was the dominant social behaviour, while elaboration consistently emerged as the most frequent integrated behaviour across the five activities. These patterns indicate that Facebook group discussions primarily supported sustained peer interaction, group coordination, and the clarification and expansion of ideas. The study contributes empirical evidence based on authentic online interaction data and demonstrates the value of quantitative content analysis for examining collaborative learning processes. The findings offer practical guidance for designing structured online activities that foster meaningful discussion, knowledge co-construction, and active participation in higher education.

Contribution/Originality: This study contributes to online collaborative learning research by analysing students' actual discussion comments rather than relying only on self-reported data. The findings show how cognitive, social, and integrated behaviours supported content engagement, interaction, coordination, idea development, and collaborative knowledge construction. Methodologically, the study demonstrates the usefulness of quantitative content analysis for examining online

collaborative learning behaviours.

1. Introduction

Online collaborative learning (OCL) has become an important approach in higher education, enabling students to exchange ideas, solve problems, and construct knowledge through digital interaction (Herrera-Pavo, 2021; Qureshi et al., 2023; López-Carril et al., 2025). Grounded in Social Constructivism and Computer-Supported Collaborative Learning (CSCL), OCL views knowledge construction as a social process shaped by interaction, participation, and collaboration among learners (Saleem et al., 2021; Hmelo-Silver & Jeong, 2021). Examining students' collaborative behaviours is therefore essential for understanding how learning develops within online environments (Chen et al., 2020; Yang et al., 2024).

Facebook has been used to support OCL in higher education because its commenting, reaction, notification, and resource-sharing features facilitate interaction beyond scheduled classroom sessions (Todorovic et al., 2021; Ulla & Perales, 2021). Its familiar and accessible interface may also support sustained peer communication and group discussion (Wu & Wang, 2023; Yılmaz & Yılmaz, 2023). These features make Facebook group discussions a relevant context for examining how students interact, coordinate tasks, and develop ideas collaboratively.

Previous studies on Facebook-supported learning have predominantly examined student engagement, perceptions, satisfaction, technology acceptance, and learning outcomes (Colomé Cedeño et al., 2020; Afroze, 2024; Apoko & Waluyo, 2025). Less attention has been given to students' observable collaborative learning behaviours within actual discussion data. Consequently, limited evidence is available on how cognitive, social, and integrated behaviours are demonstrated across structured collaborative activities. Analysing discussion comments through a behavioural coding framework provides direct evidence of how students respond to peers, manage group tasks, evaluate contributions, and elaborate ideas during collaboration (Chen et al., 2020; Zhang & Wildemuth, 2009).

Accordingly, this study investigates the online collaborative learning behaviours through cognitive, social, and integrated collaborative learning behaviours demonstrated by undergraduate students across five Facebook-supported learning activities. This study contributes empirical evidence derived from authentic online discussion data rather than self-reported perceptions. It also applies a structured behavioural coding framework across multiple learning activities, providing methodological and practical insights into the design of online tasks that support meaningful interaction, active participation, and collaborative knowledge construction.

2. Literature Review

2.1. Online Collaborative Learning Behaviours

Online collaborative learning behaviours are observable actions that reflect how students interact, coordinate tasks, regulate learning, and construct knowledge in digital environments. These behaviours provide direct evidence of students' participation during online collaborative activities (Chen et al., 2020; Hmelo-Silver & Jeong, 2021).

Previous studies have identified behaviours such as content-related discussion, metacognitive reflection, elaboration, evaluation, task coordination, and knowledge sharing (Li et al., 2024; TriLaksono et al., 2025; Qiao et al., 2024; Admiraal et al., 2026). Their occurrence may vary according to task design, platform features, group structure, and students' prior collaborative experience (Kan & Wong, 2023; Zambrano et al., 2023). Therefore, examining these behaviours is important for understanding how students participate and construct knowledge during online collaboration**.**

2.2. Facebook-Supported Online Collaborative Learning

Social media platforms support online collaborative learning by enabling communication, discussion, and knowledge sharing beyond formal classroom settings (Ansari & Khan, 2020; Kumar & Nanda, 2024). Facebook has been used in higher education because its familiar interface and discussion features support continuous interaction among students (Ulla & Perales, 2021; Todorovic et al., 2021; Wu & Wang, 2023).

Previous studies have linked Facebook-supported learning with student engagement, communication, collaborative experience, and learning outcomes (Colomé Cedeño et al., 2020; Afroze, 2024; Apoko & Waluyo, 2025). However, most have relied on students' perceptions or outcome measures, with less attention given to observable collaborative learning behaviours in actual discussion data. As a result, limited evidence is available on how students interact, coordinate tasks, and construct knowledge during Facebook group discussions.

Therefore, this study examines undergraduate students' collaborative learning behaviours based on their Facebook Group discussion. It addresses the following research question: What are students' collaborative learning behaviours are demonstrated by undergraduate students in Facebook group discussions?

3. Methodology

3.1. Research Design

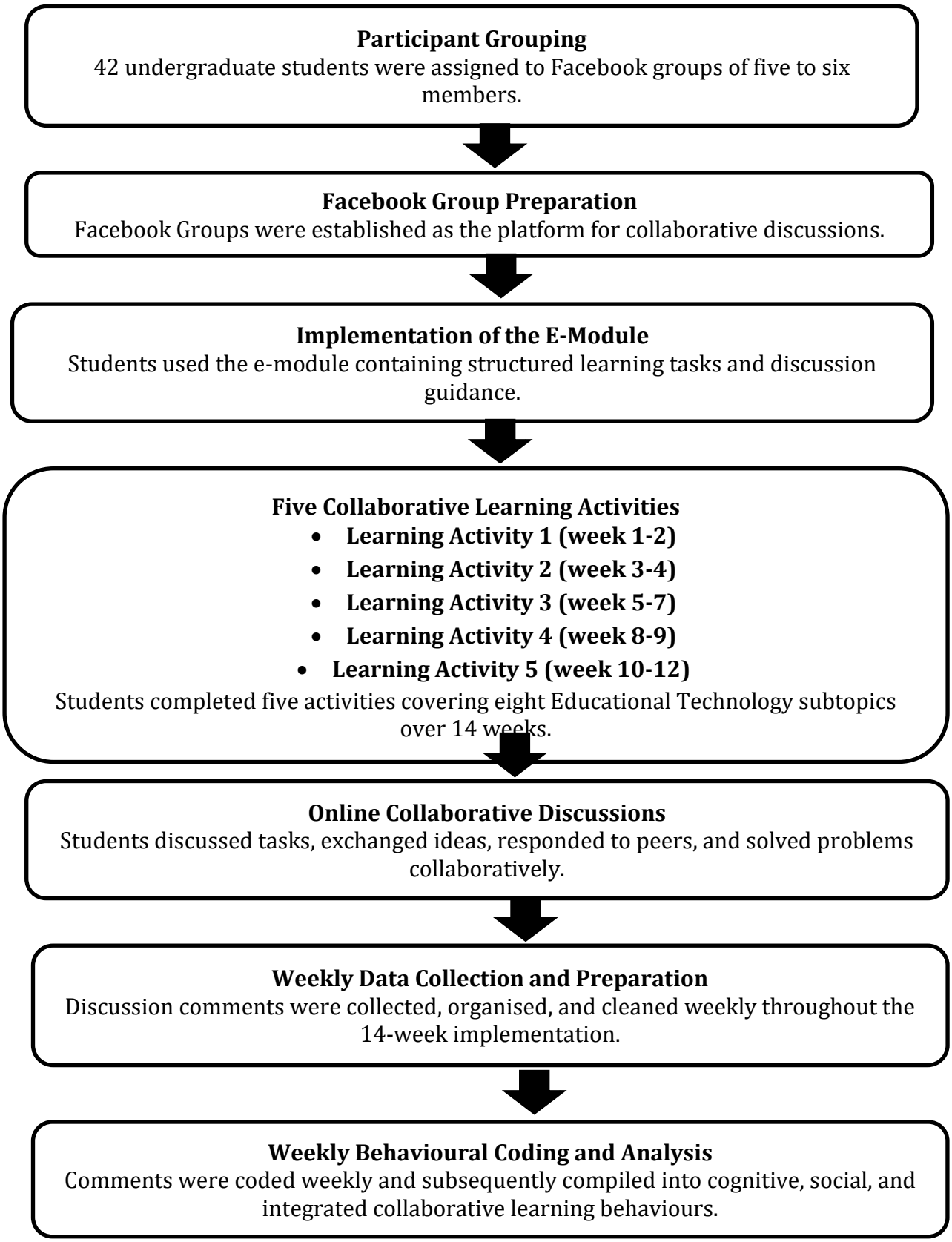
This study adopted a single-case design with quantitative content analysis to examine undergraduate students' online collaborative learning behaviours in a Facebook-supported learning environment. The design enabled the behaviours to be examined within an authentic educational context, while content analysis allowed the discussion data to be systematically coded and quantified. A key strength of this design is its ability to capture observable behaviours from naturally occurring discussion data rather than relying solely on self-reported responses. The study was conducted over a 14-week semester, during which students participated in structured online discussions through Facebook Groups.

3.2. Research Procedure

Figure 1 illustrates the sequential procedure used to examine undergraduate students' online collaborative learning behaviours in Facebook group discussions. First, 42 students were assigned to Facebook groups consisting of five to six members. The groups served as the main platform for collaborative interaction throughout the study.

Students then used an e-module containing structured learning tasks and discussion guidance.

Figure 1: Research Procedure



Over the 14-week semester, students completed five collaborative learning activities covering eight Educational Technology subtopics. During each activity, they discussed assigned tasks, exchanged ideas, responded to peers, and solved problems collaboratively. The discussion comments were collected, organised, cleaned, and analysed weekly to ensure that students' interactions were systematically documented throughout the implementation. Each relevant comment was coded according to its dominant collaborative learning behaviour. The weekly coding results were subsequently compiled and classified into online collaborative learning behaviours across the five learning activities.

3.3. Samples

A total of 42 undergraduate students enrolled in an Educational Technology subject participated in this study. The participants were selected because they were directly involved in the Facebook-supported collaborative learning activities examined in the study. They were assigned to Facebook groups of five to six members to facilitate discussion and peer interaction.

The sample was appropriate for the single-case design, which aimed to examine collaborative learning behaviours within a specific educational context rather than to generalise the findings to a wider population. Over the 14-week semester, the participants completed five collaborative learning activities, generating sufficient discussion data for systematic content analysis (Zhang & Wildemuth, 2009; Kleinheksel et al., 2020). Participation was voluntary, and informed consent was obtained before data collection

3.4. Data Analysis

Quantitative content analysis was used to classify and quantify students' observable collaborative learning behaviours in Facebook group discussions (Zhang & Wildemuth, 2009; Kleinheksel et al., 2020). This method was appropriate because it enabled the discussion data to be systematically examined using predefined behavioural categories. Discussion comments were collected weekly throughout the 14-week implementation. The data were organised, cleaned, and screened before coding. Duplicate entries and comments unrelated to the learning activities were excluded. Each relevant comment was treated as one unit of analysis.

The comments were coded using a scheme adapted from Chen et al. (2020), which classified online collaborative learning behaviours into cognitive, social, and integrated categories. Each comment was assigned one code based on its dominant behaviour. When a comment reflected more than one behaviour, the code representing its primary communicative purpose was selected. Table 1 presents the coding categories, operational definitions, and examples.

The initial coding was conducted by the primary coder using the coding scheme adapted from Chen et al. (2020). Two additional coders independently coded 491 comments, representing 20% of the dataset, selected across the five learning activities. Before coding, the coders reviewed the operational definitions, decision rules, and examples for each category. Disagreements were resolved through discussion and consensus before the final coding was confirmed.

Inter-rater reliability was assessed using pairwise Cohen's kappa. The average coefficient was κ = .782, indicating substantial agreement among the coders (Landis & Koch, 1977). The result supports the consistency of the coding process.

Table 1: Coding scheme for online collaborative learning behaviours

Coding		**Descriptions**	**Example of Students' Discussion in Facebook group**
Cognitive	Content-related	Content or concepts about the particular subject.	*"Let us discuss Question 1"*
	Metacognition	Individuals monitor and evaluate their advancement.	*"We need to revisit this question because some points require revision".*
	Summarize	Summarize or synthesize current concepts and understanding.	*"From the point given by A, I can summarize that this learning activity…."*
	Prior knowledge	Referencing or linking their personal experiences and expertise.	*"…based on previous class, the lecturer has told these theories …."*
Integrated	Elaboration	Clarification and justification of the discussion to make it more impactful.	*"I can further explain this point to make it clearer"*
	Building ideas	Propose new ideas based on the discussion and offer solutions.	*"Based on my opinion, the hierarchical structure can be divided into several parts such as…."*
	Evaluation	Evaluate the ideas, existing knowledge, contributions, and learning process of others or groups.	*the answer you gave is not very accurate, we need to discuss it again*
	Task-related	Activities undertaken by students involve problem-solving tasks and utilizing tools.	*"If you look at question number 2, teaching activities are how we do a group discussion, right? What other teaching activities can we apply for?"*
	Group dynamics	How individuals within a group engage with one another.	AA reacted "Like" button in the previous comment. BB reacted "Love" button in your reply.
Social	Group management	Leading, coordinating, strategizing tasks, and overseeing group dynamics.	"We need to divide the questions among the group members."
	Affective	Sentiments, emotional responses, and outlooks toward fellow group	"I appreciate your support. Thanks"

Coding	Descriptions	Example of Students' Discussion in Facebook group
	members.	
Facilitation	Whenever instructors participate in group collaboration and offer facilitation.	"You can also look at other sources. Do not depend on one source only."

4. Results

A total of 2,455 Facebook discussion comments were coded into three categories of online collaborative learning behaviours: cognitive, social, and integrated. Cognitive behaviours included content-related discussion, metacognition, summarisation, and prior knowledge; social behaviours comprised group dynamics, group management, affective support, and facilitation; while integrated behaviours included elaboration, building ideas, evaluation, and task-related interaction.

As shown in Table 2, social behaviours recorded the highest overall frequency across the five learning activities, followed by integrated and cognitive behaviours. Group dynamics was the dominant social behaviour in four activities, whereas group management was highest in Learning Activity 2. Within the integrated category, elaboration consistently recorded the highest frequency across all activities. Cognitive behaviours varied across activities, with prior knowledge dominating Learning Activity 1, content-related discussion dominating Learning Activities 2 to 4, and metacognition dominating Learning Activity 5.

Table 2: Distribution of cognitive, social, and integrated collaborative learning behaviours across the five learning activities

Coding		Learning Activity 1		Learning Activity 2		Learning Activity 3		Learning Activity 4		Learning Activity 5		Overall	
		f	%	f	%	f	%	f	%	f	%	f	%
Cognitive	**Content-related**	13	14.3	17	42.5	65	55.1	18	33.3	8	25	335	13.6
	Metacognition	28	30.8	8	20	5	4.2	9	16.7	10	31.3		
	Summarise	14	15.4	9	22.5	15	12.7	17	31.5	8	25		
	Prior Knowledge	36	39.6	6	14	33	28	10	18.5	6	18.8		
	Subtotal	91	27.2	40	11.9	118	35.2	54	16.1	32	9.6		
Integrated	**Elaboration**	90	46.6	56	53.8	127	54	149	74.9	93	58.5	890	36.3
	Building ideas	47	24.4	17	16.3	18	7.7	11	5.5	14	8.8		
	Evaluation	47	24.4	25	24	85	36.2	34	17.1	26	16.4		
	Task-related	9	4.7	6	5.8	5	2.1	5	2.5	26	16.4		
	Subtotal	193	21.7	104	11.7	235	26.4	199	22.4	159	17.9		
Social	**Group dynamics**	81	44.3	61	36.7	176	45.5	154	55.8	103	47.2	1,230	50.1
	Group management	73	39.9	67	40.4	121	31.3	71	25.7	59	27.1		
	Affective	10	5.5	19	11.4	40	10.3	40	14.5	48	22		
	Facilitation	19	10.4	19	11.4	50	12.9	11	4	8	3.7		
	Subtotal	183	15	166	13.5	387	31.4	276	22.4	218	17.7		
Total of Categories		467	19.0	310	12.6	740	30.1	529	21.6	409	16.7		
Total						2455						2,455	100%

Note:
The highlighted values indicate the dominant behaviour within each category for each learning activity
f = frequency; % = percentage

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As shown in Table 2, a total of 2,455 discussion comments were coded into three categories of online collaborative learning behaviours. Social behaviours recorded the highest overall frequency, accounting for 1,230 comments (50.1%), followed by integrated behaviours with 890 comments (36.3%) and cognitive behaviours with 335 comments (13.6%). This distribution shows that students' participation in Facebook group discussions was predominantly characterised by social interaction and group coordination, while integrated behaviours also reflected the development, evaluation, and elaboration of ideas.

Within the cognitive category, four behaviours were identified: content-related discussion, metacognition, summarisation, and prior knowledge. Prior knowledge was the most frequent cognitive behaviour in Learning Activity 1, with 36 comments (39.6%). Content-related discussion was dominant in Learning Activity 2 with 17 comments (42.5%), Learning Activity 3 with 65 comments (55.1%), and Learning Activity 4 with 18 comments (33.3%). In Learning Activity 5, metacognition recorded the highest frequency, with 10 comments (31.3%). Summarisation was present across all five activities, indicating that students consistently attempted to synthesise and consolidate ideas during the discussions. Overall, the cognitive findings show that students engaged with course content, connected new information with prior knowledge, and reflected on their understanding across the learning activities.

Four social behaviours were also identified: group dynamics, group management, affective behaviour, and facilitation. Group dynamics was the dominant social behaviour in four of the five activities, recording 81 comments (44.3%) in Learning Activity 1, 176 comments (45.5%) in Learning Activity 3, 154 comments (55.8%) in Learning Activity 4, and 103 comments (47.2%) in Learning Activity 5. In Learning Activity 2, group management recorded the highest frequency, with 67 comments (40.4%). Affective and facilitation behaviours occurred less frequently across the activities. These findings indicate that students mainly used the Facebook discussions to maintain interaction, coordinate responsibilities, and manage group participation, while emotional support and lecturer facilitation were less prominent.

The integrated category consisted of elaboration, building ideas, evaluation, and task-related behaviours. Elaboration was consistently the most frequent integrated behaviour across all five activities. It accounted for 90 comments (46.6%) in Learning Activity 1, 56 comments (53.8%) in Learning Activity 2, 127 comments (54.0%) in Learning Activity 3, 149 comments (74.9%) in Learning Activity 4, and 93 comments (58.5%) in Learning Activity 5. Evaluation was generally the second most frequent integrated behaviour, particularly in Learning Activity 3, where it accounted for 85 comments (36.2%). Building ideas occurred at lower frequencies, while task-related behaviour was the least frequent in most activities. However, task-related behaviour increased to 26 comments (16.4%) in Learning Activity 5. These findings suggest that students frequently clarified, justified, and extended ideas, while some activities also required more direct task coordination and problem-solving.

The distribution of comments also varied across the five learning activities. Learning Activity 3 generated the highest number of coded comments, with 740 comments (30.1%), followed by Learning Activity 4 with 529 comments (21.6%), Learning Activity 1 with 467 comments (19.0%), and Learning Activity 5 with 409 comments (16.7%). Learning Activity 2 recorded the lowest level of interaction, with 310 comments (12.6%). The higher number of comments in Learning Activity 3 indicates that this activity generated the greatest level of participation, whereas the lower frequency in Learning Activity 2 suggests comparatively less interaction.

Overall, social behaviours were the most frequently observed category, followed by integrated and cognitive behaviours. Group dynamics was the dominant social behaviour in most activities, while elaboration was consistently the dominant integrated behaviour. These findings show that Facebook group discussions supported sustained peer interaction, group coordination, and the collaborative development of ideas across the five learning activities.

5. Discussion

The findings show that students' online collaborative learning behaviours comprised three main categories: cognitive, social, and integrated behaviours. All three categories were observed across the five Facebook-supported collaborative learning activities, although their frequency varied by activity. Social behaviours were the most frequently observed, followed by integrated and cognitive behaviours. This pattern suggests that peer interaction and group coordination formed the main basis of participation, while cognitive engagement and idea development supported the broader collaborative learning process.

5.1. Cognitive Behaviours

Cognitive behaviours accounted for 13.6% of the coded comments and included content-related discussion, metacognition, summarisation, and prior knowledge. Their distribution varied across the five activities. Prior knowledge was dominant in Learning Activity 1, content-related discussion was dominant in Learning Activities 2, 3, and 4, and metacognition was most frequent in Learning Activity 5. This variation suggests that different activities prompted different forms of cognitive participation. Some tasks encouraged students to connect new information with prior learning, whereas others required closer engagement with course content or reflection on their understanding.

These findings are consistent with studies showing that content-focused discussion, metacognitive reflection, and knowledge integration contribute to deeper collaborative learning (Qiao et al., 2024; Li et al., 2024; Admiraal et al., 2026). The presence of summarisation across all activities further indicates that students attempted to organise and consolidate ideas shared during the discussions. Although cognitive behaviours were the least frequent category, they remained important because they reflected how students processed information, connected ideas, and monitored their understanding during collaboration.

The findings suggest that online collaborative activities should include prompts that require students to explain concepts, relate new information to prior knowledge, summarise group ideas, and reflect on their understanding. Such prompts may

strengthen the cognitive quality of online discussions rather than merely increasing the number of contributions.

5.2. Social Behaviours

Social behaviours accounted for 50.1% of all coded comments, making them the most frequently observed category of online collaborative learning behaviours. This category included group dynamics, group management, affective behaviour, and facilitation. Group dynamics was dominant in four of the five activities, while group management was highest in Learning Activity 2. This pattern indicates that students frequently interacted with peers, coordinated responsibilities, and sustained group participation throughout the activities.

One possible explanation is that Facebook's communication features, including comments, reactions, notifications, and file sharing, facilitated continuous interaction and task coordination. These features may have helped students maintain communication beyond scheduled learning sessions. This interpretation is consistent with previous studies emphasising the importance of communication, peer interaction, and group coordination in collaborative learning (Kan & Wong, 2023; Silva et al., 2023; Admiraal et al., 2026).

Affective and facilitation behaviours were less frequent than group dynamics and group management. The lower level of facilitation may reflect the student-centred design of the activities, in which students were expected to manage discussions and complete tasks with limited lecturer intervention. However, the increase in affective behaviour during Learning Activity 5 suggests that emotional support became more visible in some activities. This highlights the need to balance learner autonomy with appropriate facilitation and opportunities for peer encouragement, particularly when tasks are complex or require sustained collaboration.

5.3. Integrated Behaviours

Integrated behaviours accounted for 36.3% of the coded comments and included elaboration, building ideas, evaluation, and task-related behaviour. Elaboration was consistently the dominant integrated behaviour across all five activities, with its highest proportion recorded in Learning Activity 4. This finding indicates that students frequently clarified, justified, and extended ideas rather than merely posting brief responses. Such behaviour reflects collaborative knowledge construction, as students developed understanding by responding to and building on the contributions of others.

This finding is consistent with previous research identifying elaboration as an important behaviour for deeper understanding and knowledge co-construction in online discussions (Haataja, 2022; Peralta et al., 2025). It also aligns with Afram et al. (2026), who showed that technology-mediated interactions can reveal how knowledge develops through collaborative exchanges. The asynchronous nature of Facebook discussions may have supported elaboration by allowing students time to review earlier comments and prepare more detailed responses. However, this remains a possible explanation rather than a direct finding of the present study.

Evaluation was also prominent, particularly in Learning Activity 3, indicating that some activities encouraged students to assess and respond critically to ideas. In contrast, task-

related behaviour was relatively low in the first four activities but increased in Learning Activity 5. This suggests that the final activity may have required more direct attention to task completion and problem-solving. The higher overall number of comments in Learning Activity 3 also suggests that activity design may have influenced the intensity and form of participation.

Overall, the three categories of online collaborative learning behaviours played complementary roles. Social behaviours supported interaction and coordination, cognitive behaviours reflected engagement with content and reflection, and integrated behaviours supported the development, evaluation, and extension of ideas. Therefore, structured online tasks should encourage students not only to participate socially but also to explain, evaluate, and build on ideas. Prompts that require evidence, reflection, peer critique, and solution development may help produce a more balanced pattern of cognitive, social, and integrated behaviours.

5.4. Implications of the Findings

The findings provide several theoretical, methodological, and practical implications for online collaborative learning in higher education. From a theoretical perspective, the findings support the principles of Social Constructivism and Computer-Supported Collaborative Learning (CSCL), which emphasise that knowledge is constructed through interaction, discussion, and collaboration among learners. The findings further demonstrate that online collaborative learning behaviours comprise three interrelated categories: cognitive, social, and integrated behaviours. Rather than functioning as separate components, these behaviours played complementary roles throughout the collaborative learning process. Social behaviours supported interaction and group coordination, cognitive behaviours reflected engagement with content and reflection, and integrated behaviours facilitated the elaboration, evaluation, and development of ideas.

From a methodological perspective, the study demonstrates that quantitative content analysis provides a systematic approach for identifying, classifying, and quantifying observable collaborative learning behaviours in online discussion data. Compared with questionnaire-based methods, behavioural coding offers deeper insight into how cognitive, social, and integrated behaviours are demonstrated during the learning process. This approach may be adapted to examine collaborative interactions on other digital platforms and in different educational contexts. However, content analysis captures only behaviours expressed through written comments and may not fully represent unrecorded interactions or students' internal thinking processes.

From a practical perspective, the findings suggest that educators should design online collaborative activities that promote a balanced combination of cognitive, social, and integrated behaviours. Activities should require students to explain concepts, connect new information with prior knowledge, evaluate peer contributions, provide constructive feedback, and extend the ideas of others. Clearly defined group roles, structured peer-response requirements, and task-specific discussion prompts may help students move beyond simple participation towards deeper collaborative knowledge construction.

The findings also highlight the importance of appropriate lecturer facilitation and emotional support. Although students demonstrated strong peer interaction and group

coordination, affective and facilitation behaviours occurred less frequently. Educators should therefore provide sufficient guidance without limiting learner autonomy. Periodic feedback, guiding questions, encouragement, and targeted intervention may help maintain productive interaction, support less active students, and promote more balanced participation throughout the collaborative learning process.

6. Conclusion

This study investigated students' online collaborative learning (OCL) behaviours across Facebook-supported collaborative learning activities using quantitative content analysis. The findings revealed that OCL behaviours comprised three main categories: cognitive, social, and integrated behaviours. Social behaviours were the most frequently demonstrated, followed by integrated and cognitive behaviours. This pattern indicates that students' participation was largely characterised by sustained peer interaction, group coordination, and task management. Within the integrated category, elaboration emerged as the most dominant behaviour, showing that students actively clarified, justified, and extended ideas while responding to their peers.

This study contributes to the literature on online collaborative learning by providing empirical evidence derived from students' observable discussion comments rather than relying solely on self-reported perceptions, engagement, or learning outcomes. It also clarifies how cognitive, social, and integrated behaviours functioned together during collaborative learning, with social behaviours supporting interaction and coordination, cognitive behaviours reflecting engagement with content and reflection, and integrated behaviours facilitating the development, evaluation, and extension of ideas. Methodologically, the study demonstrates the value of quantitative content analysis as a systematic approach for identifying, classifying, and quantifying collaborative learning behaviours in online discussion data.

Practically, the findings provide useful guidance for educators in designing structured online collaborative activities. Clear discussion prompts, peer-response requirements, defined group roles, appropriate lecturer facilitation, and opportunities for reflection and emotional support may help promote a more balanced combination of cognitive, social, and integrated behaviours. These strategies may encourage students to move beyond simple participation towards meaningful peer interaction, deeper idea development, and collaborative knowledge construction in higher education.

7. Limitations and Future Research

Several limitations should be acknowledged. First, the study was conducted at a single higher education institution and involved students enrolled in one Educational Technology subject. Therefore, the findings may not be fully transferable to students from other institutions, academic disciplines, subjects, or learning contexts. Second, the study focused exclusively on observable behaviours demonstrated through written Facebook discussion comments and did not examine students' perceptions, motivation, learning outcomes, or interactions that may have occurred outside the platform.

Future research should involve participants from different institutions, academic disciplines, and subjects to determine whether similar behavioural patterns emerge across broader educational contexts. Future studies may also compare collaborative behaviours across multiple online learning platforms and integrate discussion data with

questionnaires, interviews, or performance measures through mixed-method designs. In addition, sequential analysis, lag sequential analysis, and social network analysis could be employed to investigate how behaviours develop over time, which behaviours tend to occur in sequence, and how interaction structures influence collaborative participation across learning activities.

Ethics Approval and Consent to Participate

This study obtained ethics approval from the Research Management and Innovation Centre (RMIC), Universiti Pendidikan Sultan Idris, under reference number 2022-0694-01.

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Conflict of Interest

The authors declare that they have no conflicts of interest to report regarding this study.

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