Mapping Interactional Progression in Synchronous Online Discussions

Obaida Chaqmaqchee, Shamala Paramasivam, Ramiza Haji Darmi, Vahid Nimehchisalem

Universiti Putra Malaysia, Malaysia

Email: obayda_sami@yahoo.com

Abstract

Synchronous online group discussions are commonly recognized as a rich site for collaborative learning, where learners construct their understanding by actively participating to create a collective understanding. However, the interactional mechanics that support real-time collective understanding are under-explored. Understanding the complex range of learners' contributions has important implications for understanding the relationship between interaction and cognitive engagement. This study examines the internal mechanisms of knowledge construction in online discussions using the patterns of interaction and degree of linguistic complexity. A total of six video-recorded group sessions were transcribed. The complex analysis employed both an interactional framework and quantitative measures of lexical density. The results indicate that the early stages of group discussion segments tended to focus on background and shared information, often contributing most frequently to the knowledge construction process, but demonstrated relatively low lexical density as learners were largely negotiating shifting pieces of information. In contrast, segments that involved negotiation and critical evaluation occurred less frequently and suggested the proportion of richer content words, representing a higher cognitive engagement; while the stages of discussion mirrored a cyclical approach, with contributions constantly reviewed and reiterated to clarify ideas. The study contributes more broadly to understanding the relationship between the structure of discourse and richness of linguistic contribution in supporting collaborative learning. The study provides a practical metric for assessing cognitive depth, which can inform the development of automated feedback systems for facilitators. The integration of interactional and linguistic analysis offers practical underlining dynamics of online group discussions.

Keywords: online discussion, collaborative learning, interaction analysis, linguistic complexity, knowledge construction

Introduction

The rapid expansion of online learning has transformed higher education landscapes. It provides pivotal platforms for collaborative learning (Lowenthal, 2022; Camilleri & Camilleri, 2022). Digital learning has reshaped interactional mechanisms of shared dialogue and evolving understandings. Among these, online synchronous discussions are widely acknowledged for their potential to promote deeper collaboration (Maia et al., 2021). However, the efficacy of such environments depends on the quality and structure of interaction.

Despite growing interest in online collaborative learning, much remains unknown about the specific interactional processes through which learners build understanding together (Chen & He, 2023; Kamariah et al., 2023; Maqsood et al., 2024). Synchronous discussions, in particular, pose unique communicative and cognitive demands, requiring participants to coordinate

meaning and manage social dynamics collaboratively to build upon each other's ideas and create shared understanding (Lucas and Moreira 2010). While recent discourse-based studies have begun to explore these dynamics, most research continues to focus on macro-level outcomes. These studies offer limited insight into how knowledge is actually co-constructed during the flow of conversation. Fine-grained analyses of how learners initiate, sustain, and transform group dialogue are still scarce (Widdersheim, 2015; Azmat & Ahmad, 2022).

Real-time turn-taking, immediacy, and the absence of non-verbal cues create a unique interactional ecology that differs significantly from asynchronous forums. Synchronous discussions may provide a greater sense of focus and immediacy; however, the rapid pace of these discussions can also limit depth of reflection (Luo et al., 2023; Khilya et al., 2024). Simultaneously, reports of decreasing learner motivation and engagement (Almendingen et al., 2021; Chim et al., 2024) illustrate the inadequacy of conventional evaluative frameworks. These frameworks often do not include the operationalization of how knowledge is formed collaboratively in real-time talk.

This study aims to explore the internal structure of collaborative learning by analysing the interactional sequences and linguistic complexity of learners' contributions to synchronous online discussions. This study combines interactional analysis with lexical profiling to meaningfully highlight how or whether discourse which is happening in real-time, supports or constrains knowledge construction.

Literature Review

Interactional Framework for Collaborative Meaning-Making

Analyzing how learners co-construct meaning during synchronous online group discussions requires a theoretical approach. This theoretical approach must view discourse not only communication, but a socially situated context for learning. This study is anchored in an approach similar to sociocultural and discourse-interactional perspectives, with an emphasis on real-time interaction as a primary mechanism of collaborative meaning-making. Focal to this approach is Vygotsky’s (1978) concept of socially mediated learning, which posits that development occurs through individuals dialogically engaging with more capable peers in a community while using culturally mediated semiotic tools. Lantolf and Poehner (2008) build on this concept by proposing that mediation is not only limited to formal instruction; it occurs dynamically, and thus, emergently, in spontaneous interaction. This is particularly pronounced in synchronous learning environments, in which learners are required to respond to ongoing discourse in the moment. Mercer and Littleton (2007) further this in arguing that shared understanding is dialogically constructed: learners negotiate, align, and adapt their understandings in communication, with little time to reflect after each interaction. The exchanges between learners are therefore, not only transactional, but also constitutive acts of joint reasoning.

Building on this, Smith’s (1994) Group-Mediated Cognition (GMC) offers an interaction-centered view of learning as a collective, dialogic process. In this view, meaning is not constructed individually and then exchanged, but emerges through dialogic turns, where learners’ contributions are built upon, reformulated, or reoriented by peers. The focus shifts from tracking isolated cognitive moves to analyzing how conceptual coherence is achieved collectively over time.

Informed by these perspectives, this study treats online group discussions as discursive events in which knowledge is collaboratively shaped through structured interaction. The emphasis is not on individual cognition, but on the participatory architecture of discussion, how learners

sustain focus, revisit ideas, and build alignment. Here, language functions not just as a means of expression, but as a tool for joint reasoning, scaffolding, and meaning alignment. The aim is to investigate how interactional sequences contribute to collaborative knowledge construction. Particular attention is given to the recursive and adaptive organization of dialogue in real-time, synchronous settings.

Empirical Perspectives on Online Group Discussions

Although research on online collaborative learning has expanded, it has predominantly centred on asynchronous platforms such as discussion forums and chatrooms to examine learning as a social process (Paulus, 2006; Lucas et al., 2014; de Laat & Lally, 2003). These studies often rely on surface-level indicators, such as message frequency, word count, and participation rates, that offer limited insight into the quality and depth of interaction (Tirthali & Murai, 2024; Widdersheim, 2015). More recent scholarship has called for the need to better understand how shared meaning is developed collaboratively (Chen & He, 2023; Kamariah et al., 2023). However, there remains a notable gap in research that closely examines real-time discourse practices in synchronous environments.

Gunawardena et al.'s (1997) Interaction Analysis Model (IAM) remains an important way to understand how learners construe knowledge over five recursive phases, from the sharing of information to the application of new knowledge. However, while the IAM can be helpful, it and other models face challenges in articulating the dynamic, recursive, habitually undertaken, and culturally mediated nature of synchronous discussions. In many studies, researchers observe learners remaining in the early phases of interaction, rarely appropriately negotiating and integrating (Ciampi et al., 2018; Lim & Park, 2023; Lucas et al., 2014). For instance, Paulus (2006), reported less than 10 percent of the contributions moved beyond the initial phase of sharing information, while Park et al. (2020) report limited movement even in "well-established" online learning contexts.

This study extends these findings by examining how phases of interactive behavior are achieved and sustained by repeated discourse sequences. Instead of looking at engagement from a lens of rate and type of participation, this study treats participation as an emergent property of an engagement structure. This includes both the interactional structure of participation and the linguistic complexity of learners' contributions, to examine or understand how learners manage or negotiate transitions between engagement phases. By accomplishing such a goal, we move beyond coding systems and can analyze both fluidly and in context how collaborative knowledge building occurs in synchronous discussions. This study seeks to offer a more nuanced interpretation of the Interaction Analysis Model (Gunawardena et al., 1997) by moving beyond phase-based frequency counts to explore the interactional dynamics and linguistic complexity that characterize each phase. In doing so, it responds to the limitations of earlier research (e.g., Ciampi et al., 2018; Lucas et al., 2014), which often equated learning progression with the quantity of contributions in each phase, rather than the quality and function of discourse within and across phases.

Methodology

Research Design

This investigation purports an explanatory instrumental case study framework to study collaborative learning, which occurs as a result of interactional dynamics resulting from

synchronous online group discussions (Merriam, 1988). This case study operates under a sociocultural and discourse-interactional theoretical framework within a bounded context, with Iraqi undergraduate learners. The explanatory intention will enable further understanding about how participants engage and maintain movement across interactional phases in real-time. In this case, the study will be primarily qualitative. It consists of a linguistic profiling which uses vocabulary density analysis to draw attention to the cognitive workload associated with opportunities for conversation at different levels of discourse. This combination of methodologies allows a dual focus on the structure and linguistics of collaboration, providing a detailed account of the meaning-making process, which has often been ignored in existing synchronous learning environment studies.

Participant Selection and Context

The study focuses on a purposive sample of 20 Iraqi undergraduate English majors enrolled in the Pedagogy and Curriculum Innovations course at a public university in Iraq. The participants, aged 21–23, were chosen based on their high level of engagement in synchronous online academic discussions. Criteria for selection were developed to ensure that the sample represents a typical microcosm of peer interaction in the given context, while also being manageable for deep qualitative analysis. The participants distributed into five per group, this number was deemed sufficient to reach data saturation within the context-specific exploration of interactional patterns. Pseudonyms (S1–S5) are used to protect participant confidentiality.

Data Collection

Data were generated through six synchronous discussion sessions conducted via Google Meet over a two-week period. They engaged in a discussion task developed collaboratively by the researcher and the course lecturer, focusing on the integration of learners' first language (L1) into English instruction. The task was designed to encourage critical engagement and elicit a range of perspectives. Participants responded to the guiding question: "Do you advocate for a strict English-only environment in second language learning, or should learners' first language be integrated into instruction?" This topic was selected for its pedagogical relevance and its potential to stimulate meaningful interaction aligned with the study's analytical aims. Google Meet was chosen for its accessibility and support for real-time, naturalistic communication. While technological issues can occasionally affect online interaction, potential disruptions were minimized through orientation sessions and participants' familiarity with the platform. All sessions were recorded and transcribed verbatim. Transcripts were then reviewed and validated by the researcher to ensure accuracy.

Analytical Strategy

The analysis focused on the interactional and knowledge-construction dimensions of online group discussions, aiming to explore how participants developed shared understanding. Gunawardena et al.'s (1997) Interaction Analysis Model (IAM) was employed to categorize interaction phases and trace learners' progression from individual contributions to collective meaning-making (Table 1). To complement the interactional analysis, lexical density was examined to assess the linguistic complexity associated with each phase. Coding was conducted using Atlas.ti24, beginning with inductive category development and followed by theory-driven refinement. A second coder reviewed the coding scheme to enhance credibility, and discrepancies were resolved through discussion. Procedural talk (e.g., technical or logistical remarks) was excluded to ensure the analysis focused on content-relevant discourse.

Table 1: Interaction Analysis Model (Gunawardena et al., 1997)

Phase I: Sharing/Comparing of Information
A. A statement of observation or opinion
B. A statement of agreement from one or more other participants
C. Corroborating examples provided by one or more participants
D. Asking and answering questions to clarify details of statements
E. Definition, description, or identification of a problem
Phase II: The discovery and exploration of dissonance or inconsistency among ideas, concepts, or statements
A. Identifying and stating areas of disagreement
B. Asking and answering questions to clarify the source and extent of disagreement
C. Restating the participant's position
Phase III: Negotiation of meaning/co-construction of knowledge
A. Negotiation or clarification of the meaning of terms
B. Negotiation of the relative weight to be assigned to types of argument
C. Identification of areas of agreement or overlap among conflicting concepts
D. Proposal and negotiation of new statements embodying compromise, co-construction
E. Proposal of integrating or accommodating metaphors or analogies
Phase IV: Testing and modification of proposed synthesis or co-construction
A. Testing the proposed synthesis against ''received fact" as shared by the participants and/or their culture
B. Testing against existing cognitive schema
C. Testing against personal experience
D. Testing against formal data collected
E. Testing against contradictory testimony in the literature
Phase V: Agreement statement(s)
A. Summarisation of agreement(s)
B. Applications of new knowledge
C. Metacognitive statements by the participants illustrating their understanding
the conference interaction

Results

Interactional Dynamics in Online Discussions

This study examined how contribution sequences and structures influenced the collaborative construction of ideas in synchronous online discussions using Gunawardena et al.'s, (1997) Interaction Analysis Model (IAM). Data illustrated that interactional progression unfolded recursively rather than hierarchically, with participants' progression not consistently showing a linear or fixed order, as participants entered phase I sometimes moved to phase V, then returned to earlier phases. Phases emerged periodically rather than entrapped in a specified order.

The most prevalent phase of interaction occurred in phase I when participants were sharing ideas or exchanging general information. These segments played a conceptual supporting role to initiate and keep group conversation active. Far from demonstrating lack of interest or superficiality, this phase was simply a point of reference for the conversation in which participants could re-familiarize themselves with ideas, augment previous content, or keep the entire discussion aligned. Progressing into the next phases of construction, the phase of meaning negotiation and integration of ideas, was a long, progressive effort by participants. Individual participants did not share an experience of linear progression. Rather, discourse practices emerged and often returned for revisiting original contributions, using and reintroducing original contributions to support creating an evolving insight. For many participants, this entailed returning to original ideas to either revise and/or extend original ideas, which all contributed momentum to developing sharable knowledge.

Although higher-level phases occurred less frequently, they were marked by increased engagement with prior content and deeper exploration of perspectives. Transitions between phases were often facilitated by the cumulative nature of dialogue, in which ideas were not replaced but layered and reorganized through ongoing interaction. Some threads showed limited development beyond the early stages. In these cases, interaction remained at the level of information exchange, with few signs of integration or synthesis. However, even in such instances, the repetition of earlier phases served as a cohesive mechanism, supporting the overall continuity of group discussion.

These findings illustrate that the effectiveness of collaborative online discussions depends not on linear progression through predefined phases, but on the dynamic and recursive organization of contributions over time. The structure of interaction, including how often and how effectively participants re-engaged with prior content, played a critical role in shaping the trajectory and depth of group discussions.

Toward a Dynamic Understanding of the IAM

As illustrated in Figure 3, Phase I emerged as the most frequent phase across the discussions. Its dominance is not merely a result of frequent informational exchanges but signals its referential and organizational function within the broader structure of collaborative discourse. Although Phases II through V occurred with decreasing frequency, the interactional flow did not proceed in a strict linear order. Instead, the data revealed a cyclical and recursive pattern, with Phase I serving as a frequent point of return.

Transitions often began in Phase I, progressing through the subsequent phases. However, learners regularly looped back to Phase I, suggesting it served as an anchor point, a discursive space where participants revisited prior knowledge, clarified ideas, or re-established shared understanding before advancing. Rather than interpreting the recurrence of Phase I as a sign of shallow discussion, this pattern reflects the dynamic and iterative nature of collaboration in synchronous settings. The high recurrence of Phase I underscores its epistemic role: it functioned as a flexible zone for conceptual clarification and coherence maintenance, helping sustain movement across the interactional cycle. In this sense, Phase I acted as a mechanism of continuity rather than a ceiling to cognitive depth.

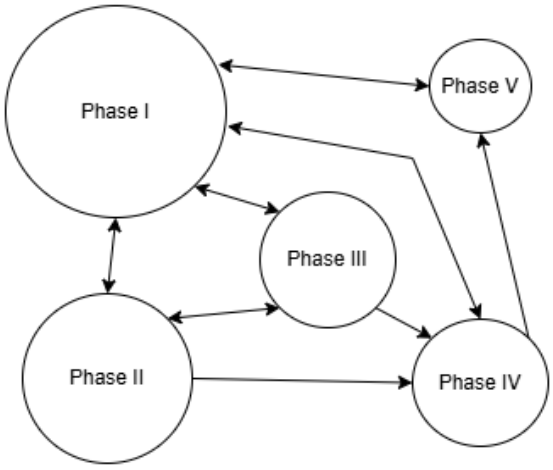

Figure 3. Distribution and Recurrence of Phases in the Interaction Analysis Model (IAM).

In addition to tracking phase frequency, the study examined lexical density across the IAM phases (see Figure 4). Lexical density, defined as the proportion of content words (nouns, verbs, adjectives, adverbs) relative to total word count, was analyzed using part-of-speech (POS) tagging in a basic natural language processing (NLP) framework.

Findings showed notable variation. Phase I, despite its dominance in frequency, had the lowest lexical density (44.6%), reflecting simpler language use and frequent referencing or re-anchoring. In contrast, Phases III and IV, associated with conceptual elaboration and negotiation, showed significantly higher lexical density (67.7% and 70%, respectively). This increase reflects the greater linguistic complexity and cognitive demand required in deeper discussion phases. The density patterns suggest that as learners move toward more conceptual engagement, their language becomes more content-rich, precise, and semantically dense.

Taken together, frequency and lexical density illuminate the complementary functions of different phases. Phase I, while structurally dominant, served as a foundational reference point that sustained the interactional rhythm. Phases III and V, though less frequent, showed greater cognitive intensity, marked by higher lexical complexity. These findings reinforce the value of integrating qualitative interactional analysis of learners' discussions across the five phases with quantitative linguistic profiling to uncover how discourse patterns reflect cognitive engagement, not only through structural movement across phases, but also through the richness of the language used.

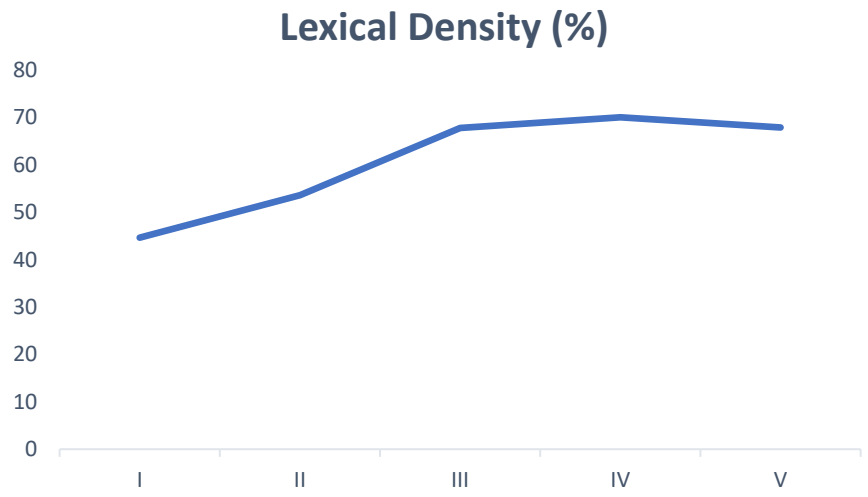

Figure 4. Lexical Density across IAM phases

Discussion

This study examined the interactional process and linguistic features of synchronous online discussions through Gunawardena et al.'s (1997) Interaction Analysis Model (IAM) and a lexical density analysis. Our analysis showed a dynamic and recursive movement through the IAM phases. Phase I, Sharing/Comparing of Information was noted more frequently from participants for conceptual clarification and maintaining coherence and connectionit had a much lower lexical density than the other phases. Phases III, Negotiation of Meaning and IV, Testing and Modification of Proposed Synthesis had a much higher lexical density than the other phases, to show more linguistic complexity and more cognitive demand from the three

readings. From our findings, it is evident that there are complementary functions in all the interactional phases when considering collaborative knowledge construction and interaction in an online environment. Both the structural shift across the phases and the language used within the phases certainly come together to make a contribution related to cognitive engagement.

Non-Linearity and Recursiveness in IAM Progression

Similar to our observation of the occurrence of phases in online dialogue occurring in a circular, repeated process, with frequent returns to Phase I, is consistent with and extends research on collaborative knowledge construction. While Gunawardena et al. (1997) sketched a linear trajectory through the five phases, subsequent research has found many examples of the non-linear, recursive nature of online interactions (Mohamed and Abdallah, 2021). They found that online learning participants do not follow each phase linearly in a strict process. They often return to Phase I to clarify understanding, or re-establish common ground, before moving on to complex and higher-order knowledge construction.

This recursive pattern is significant. In particular, the nature of anchoring Phase I roles suggests that the construction of information-sharing is not just an initial step, but a continuous process. This process is important for sustaining collaborative dialogue and ultimately for group members' collective understanding of the topic or subject of learning, if achieved at all, mostly in dynamic synchronous settings. This finding shows the need to avoid rigidly interpreting the IAM as a strictly linear model. Instead, a more adaptable understanding of the model better characterize the findings in this study with an adaptable and fluid understanding of its use to analyze higher-level collaborative knowledge construction in online interactions. This challenge earlier interpretations (Ciampi et al., 2018; Lim & Park, 2023; Lucas et al., 2014) in which participants contributions were normally evaluated only by the quantity of contributions, in each phase of the Gunawardena et al.'s (1997) model. Nevertheless, this more recent work by Campeny et al. (2018) and Lim and Park (2023), gives further credence to this non-linear approach indicating that knowledge construction is an inherently iterative process when it occurs in online environments (Aldulaimi et al 2018; Mohamed and Abdallah, 2021).

Lexical Density and Cognitive Engagement

The differences in lexical density in the IAM phases provide new perspectives about the cognitive demands and linguistic features associated with the various stages of collaborative knowledge construction. By examining lexical density in the IAM phases, this study illustrates how the form of language (i.e. its complexity) parallels the function of interaction (i.e. its cognitive purpose). This enhances our understanding of how learners think and communicate to build knowledge in online environments.

The low lexical density in Phase I (44.6%) indicates a proclivity for less complex, and more straightforward language, which is presumably to promote transactional exchange of information and clarification. There are significant differences in lexical density in Phases III (67.7%) and IV (70%), which are linked to cognitive elaboration, meaning-making and synthesis. Moreover, the pattern is evident that as learners engage in increasingly complex cognitive processes, their language becomes both more content dense and semantically rich. The observation is aligned with previous studies (Gatiyatullina & Solnyshkina, 2020; Zhou et al 2023; Qin & Wen, 2023) into linguistic complexity in academic discourse suggesting that higher lexical density provides the most formal, informative and cognitively challenging texts.

There is little evidence in the literature which directly studies the notion of lexical density across the phases of the IAM. However, studies on other linguistic aspects of the movement between, for instance, coherence and collaboration, across the medium of online discussions correspond to increased linguistic complexity, defined as more extensive, and aspect of higher order thinking and therefore knowledge construction. For example, Jahromi (2020) observed that placing students in online discussions developed their lexical variation, richness, and density. In another study, Laat and Lally (2004) observed that online discussion allows for a developmental pattern of higher order thinking, usually reflected through more complex and denser lexicon (Al-Shami et al., 2022). Though De Laat and Lally (2004) noted that online discussion facilitated higher-order thinking, as measured by lexical richness, their analysis was not based upon an interactional framework. The present study compares lexical density across the specific stages of the Gunawardena et al. (1997) phases, providing a more accurate account of linguistic complexity as it develops through real-time collaborative learning. Our understanding of the distinctions between the moving phases of IAM is enriched through proposed mappings to linguistic transitions, as well as conversations to linguistic transitions. Distinctly, we are able to assign a quantitative linguistic abstraction to qualitative descriptions of experience through the mapping of the IAM cognitive phases in developing cognitive engagement through discourse building. This approach enables us to go beyond mere positioning or structure of a phase into descriptive movement through a rich use of language.

This study offers more than an endorsement of the non-linearity inherent in IAM phases and the relevance of lexical density. For practitioners, it should be emphasised that the overlapping of Phase I should not be, nor is it likely to be, interpreted as a lack of progress, rather it should be understood as a deliberate and purposeful return to enhance collective understanding of the group in the study of qualitative knowledge development. By designing prompts that require iterative clarification participants may develop a deeper knowledge that extends beyond factual knowledge construction. It is possible that lexical density could also be used as a real-time indicator of whether knowledge construction is taking place in learning spaces in asynchronous or synchronous online settings. This possibility may also encourage the consideration of developing automated tools that monitor the complexity of language used in on-line discussions and alert educators when prolonged periods of shallow discussion occur. The most recent work of Chen and He (2023) that sought to evaluate AI discussions as a linguistic diagnostics device could provide support for this consideration. For researchers, new possibilities emerge, such as quantifying cognitive depth when we include linguistic metrics (i.e., lexical density) in IAM-based research. For example, studies could examine elements of syntactic complexity, hedging, or structures of argument with respect to phase transitions, or how cross-cultural influences may shape participants' understandings of culturally conditioned discourse practices (e.g. through Arabic or Western styles) that may advance or hinder learners' progress through IAM. Kamal et al.'s (2023) comparative research sets an excellent backdrop for this investigation.

Conclusion

This study provides a nuanced understanding of interactional dynamics in synchronous online discussions, demonstrating the recursive nature of collaborative knowledge construction within the IAM framework and establishing lexical density as a quantitative indicator of cognitive engagement. The study has illuminated how both the structural movement through discussion phases and the richness of language contribute to knowledge construction. These findings offer valuable insights for designing more effective online learning environments and pave the way for future research into the complex interplay of interaction, language, and cognition in digital

collaborative spaces. Specifically, the observed non-linear progression through IAM phases highlights the adaptive nature of collaborative learning, suggesting that educators should embrace iterative processes rather than strictly linear ones. The study provides a practical metric for assessing cognitive depth, which can inform the development of automated feedback systems for facilitators.

Implications

This study yields important implications for theory, pedagogy, and future research in online collaborative learning, especially within culturally specific and English as a Foreign Language (EFL) contexts.

The findings highlight that meaningful collaboration is not solely a function of participation frequency, but of how learners navigate interactional phases and develop linguistic complexity over time. Phase I's frequent recurrence, often misinterpreted as superficial, was shown to play a pivotal epistemic role in sustaining coherence and realigning shared understanding. Educators should therefore embrace rather than discourage such recursive practices. Instructional design should integrate tasks that promote cyclical refinement of ideas, allowing learners to revisit and deepen understanding over multiple turns.

Moreover, the correlation between higher lexical density and advanced phases of knowledge construction suggests that linguistic richness can serve as a real-time proxy for cognitive engagement. Practitioners can harness this insight by designing prompts and activities that require elaboration, synthesis, and perspective-taking, discursive actions known to foster density and deeper reasoning.

By mapping interactional sequences to lexical density patterns, this study introduces a novel methodological synergy that enriches existing discourse analysis frameworks. The integration of the Interaction Analysis Model (IAM) with natural language processing-based lexical profiling enables both structural and semantic dimensions of knowledge construction to be captured. This dual-layered approach not only enhances analytic precision but opens pathways for automated assessment tools that can monitor interactional quality and signal stagnation or conceptual drift in real time.

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