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## A Study on Learner Interaction through the Integration of Information Technology in Teaching English for specific purpose (ESP)

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### Abstract

This systematic study examines the impact of integrating information technology (IT) on enhancing interactivity in English language teaching environments. Recent studies have shown that high-quality IT integration enhances interaction, promotes communication between teachers and learners, and between learners. In addition, IT-supported environments encourage learners to collaborate with each other through a variety of technological and digital methods. The findings of the study indicate that IT is not only a means but also an active learning facilitator, especially in classroom interaction. Purposeful integration, pedagogical foundations and adequate infrastructure are essential to maximize engagement and learning outcomes. The paper synthesizes, discusses the results and proposes some measures to help improve student interaction in the English classroom through the integration of IT.

**Keywords:** IT integration, interaction quality, multimodal participation, educational technology

## 1. Introduction

Learner interaction is central to language acquisition (Long, 1996). Through negotiating meaning, framing, feedback and collaborative knowledge construction, learners build language competence together (Vygotsky, 1978). In English language teaching (ELT), these interactions play a key role in developing communication skills and promoting learner participation. The integration of information technology (IT) into English Language Teaching, including learning management systems, collaboration platforms, mobile applications, videoconferencing, and AI-enabled tools, is reshaping these interaction patterns (Salaberry, 2017; Stahl, 2006).

Despite the extensive research on technology-enhanced learning, the existing literature remains theoretically deficient. Social constructivist perspectives emphasize collaborative interaction (Vygotsky, 1978; Stahl, 2006), cognitive perspectives focus on individual processing (Clark & Mayer, 2016), and technology studies often emphasize usability or engagement without linking to interactionist theory (Salaberry, 2017). This gap highlights the need for a systematic theoretical approach that integrates these perspectives (Torraco, 2016).

This study adopts a systematic theoretical research approach, employing structured and replicable processes to develop a cohesive theoretical framework. The aim is to clarify how ICT integration influences learner interaction in English Language Teaching. The resulting framework serves both theoretical advancement and practical instructional design (Jaccard & Jacoby, 2020). This study addresses the following research question: How does ICT integration in English language teaching influence the quality of interaction according to current theory?

## 2. Theoretical background

### 2.1 Definition of terms

- Learner interaction: A back-and-forth communication exchange between learners, teachers, and content, which contributes to the negotiation of meaning, feedback, support, or collaborative task completion. This includes verbal, written, and multimodal interactions (Long, 1996; Stahl, 2006).
- Integration of Information Technology in English Language Teaching: The intentional integration of digital tools into English language teaching practice to support teaching, practice, assessment, communication or



collaboration (Salaberry, 2017).

- Interaction Quality: A composite construct that includes the depth of meaning negotiation, frequency of meaning turns, relevance to learning objectives, effectiveness of feedback and learner engagement (Garrison et al., 2000).
- Learning Outcomes: Progress in linguistic competence (vocabulary, grammar, fluency, comprehension), communicative ability and affective outcomes such as motivation and willingness to communicate (Clark & Mayer, 2016).

## 2.2 Related Theoretical Frameworks

### 2.2.1. The Interaction Hypothesis

The Platform Interaction Hypothesis (Long, 1996) suggests that language acquisition is facilitated when learners engage in meaningful interaction. Technological contexts are used as mediators to extend and diversify opportunities for learning: for example, synchronous breakout rooms or asynchronous collaborative documents facilitate both the frequency and type of interaction (Stahl, 2006). In recent studies, scholars have emphasized that digital tools not only reshape the extent to which interaction occurs, but also how it is structured and facilitated. The sociocultural perspective emphasizes that interactions are mediated by the tool and developed by the teacher's supporting framework and semiotic resources. Thus, learners' negotiation of meaning in online environments is embedded in an ecosystem of artifacts, platforms, and modalities. In this context, the quality of interaction is as important as the quantity.

### 2.2.2. Multimodal Learning Theory

Multimodal learning theory suggests that learners interact with multiple semiotic modalities (text, audio, video, gesture, image) and that these multiple channels enhance comprehension, reduce ambiguity, and promote richer interactions (Clark & Mayer, 2016; Salaberry, 2017). In technology-enhanced English Language Teaching, digital environments allow for expanded multimodal interactions: collaborative documents with embedded audio, video, shared virtual artifacts in VR/AR, synchronous chat with whiteboards, etc. Recent studies (Walkington et al., 2024) explore how multimodal interactions embodied in AR/VR support the creation and repair of meaning through gestures, movements, and shared virtual objects. The choice and design of the modality therefore influences not only the way in which interaction takes place, but also its depth and quality, the nature of negotiation and reception. In other words, multimodal interactivity becomes the intermediary of both input and output, of feedback loops and meaning-making.

### 2.2.3. Digital Learning and Connectivism

Connectivism (Siemens, 2005) and network learning theory position knowledge as distributed across networks (people, tools, resources) and learning as the ability to navigate, connect and exploit those networks (Turner, 2022). In online English Language Teaching, this theory emphasizes that interaction is not limited to exchanges between learners and instructors, but also involves networks: forums, collaborative documents, AI modules, digital

data repositories, global computers. Thus, interaction quality encompasses not only the meaning negotiated between two interlocutors, but also the ability to connect, share, coordinate, reflect, and co-construct. Recent studies (Saad & Mayer, 2025) illustrate how digital informal learning communities leverage the principles of connectivity in language learning, emphasizing networked interactions, digital knowledge, and knowledge flows. Therefore, an integrated theoretical perspective on interaction quality must consider the networking capabilities of technology, the design of networks, and how learners engage in those networks to negotiate and learn meaningfully.

Overall, these frameworks provide some clear theoretical frameworks for considering interaction quality in technology-supported English Language Teaching. The Interaction Hypothesis emphasizes mediation through tools and social interactions; Multimodal learning emphasizes the multichannel and connectivity of digital tools; Embodied cognition emphasizes the body, the involvement of the sense of movement, and the physicality of interaction; Connectivism emphasizes networked, distributed knowledge and interactions between nodes.

This theoretical context lays the foundation for analyzing how IT integration modulates both the quantity and quality of interaction in online English Language Teaching environments

## 3. Research Methodology

### 3.1 Research Design

This study used a systems theory research design to synthesize and analyze existing theoretical frameworks, conceptual models, and scholarly findings related to learner interaction in English language teaching (ET) through information technology (IT). The focus was on identifying, comparing, and integrating conceptual perspectives rather than collecting primary empirical data. This approach allowed for the development of a comprehensive conceptual understanding of how ICT integration shapes interaction quality in the context of ELT.

### 3.2 Research Sample

The "sample" in this study consisted of published scholarly works that met the inclusion criteria. A purposeful and systematic selection process was applied to ensure conceptual relevance and rigor. The sample selection criteria included: Peer-reviewed journal articles, book chapters, and systematic reviews that discussed English Language Teaching, learner interaction, and IT integration; Studies that explicitly referred to theoretical frameworks, models, or constructs related to interaction quality, negotiation of meaning, or multimodal learning; Publications from 2015 onwards that documented recent technology-supported learning activities; and Sources published in English.

Using these criteria, 42 studies were selected from major academic databases including Taylor & Francis Online, SpringerLink, ScienceDirect, ResearchGate, SAGE Journals, and PMC. A bibliographic citation method was used to identify influential works cited in these sources.

### 3.3 Data Collection

Data were systematically collected from the selected documents using a structured extraction protocol. For each source, the following information was recorded:

- Author, year of publication and source.
- Theoretical framework or conceptual model used.
- Focus on interaction type (learner-learner, learner-instructor, learner-content).
- Discussion of IT tools or digital capabilities (e.g. breakout rooms, collaborative documents, multimedia platforms, VR/AR).
- Key findings related to interaction quality, or multimodal interaction.
- Identification of research gaps and recommendations for future research.

All information was compiled into a data extraction matrix to facilitate systematic comparison and thematic coding.

### 3.4 Data Analysis

The study used qualitative thematic analysis of conceptual and theoretical data. The steps involved were:

1. Coding: Each study was coded based on the theoretical framework, interaction focus, ICT tools and key findings.
2. Classification: Codes were grouped into thematic categories such as Quality of, Interaction for learning outcomes, Active and collaborative learning participation, Factors influencing the quality of interaction
3. Synthesis: Patterns, similarities, differences and gaps between theoretical perspectives were identified to build an integrated conceptual framework of learner interaction through ICT in English language teaching.
4. Validation: Classification and synthesis were cross-checked with valid sources and literature review to ensure reliability and minimize bias in interpretation.

## 4. Research Findings and Discussion

### 4.1 ICT Integration and Learner Engagement

The impact of student engagement on learning achievement in digital environments has been studied across a variety of methodologies and contexts. Recent research has focused on a core finding: engagement plays an important role in learning, depending on the nature, quality, and context of the interaction.

#### *Performance of Learner-Content-Instructor Interactions*

Al Mamun (2022) explored learner-content interactions in guided learning environments and self-directed online environments. The study found that structured content, such as guided prompts and guided tasks, significantly predicted engagement and task success. However, Al Mamun also pointed out a gap: too little exploration of peer-instructor interactions in similar contexts. This suggests that while learner-content interaction is important, it cannot be fully understood without social and pedagogical support structures

and teacher- and context-related factors. Studies highlight a general positive correlation between interaction and learning outcomes. However, the strength and consistency of this relationship varies depending on the type of interaction (learner-learner, learner-instructor, learner-content) and instructional design. The paper points out that inconsistent operational definitions of “interaction” across studies hinder synthesis, pointing to the urgent need for standardized measures (Canals, 2023). In online learning, systematic reviews reinforce that the quality of interaction, not just the quantity, predicts engagement and performance. Akpen (2024) found that high-quality interactions mediate differences in learner performance, while Din Eak (2024) highlighted that richer feedback modalities, such as audio or video, improve clarity and receptivity. These findings suggest that learners benefit when interactions are timely, supportive, and responsive, rather than superficial or transactional.

Teacher-related factors play an important role in shaping interaction quality. Tilbe (2024) found that teachers’ training, beliefs, and pedagogical understanding strongly influence interaction quality, reinforcing previous research on the importance of professional competence. However, these studies often do not address second language instructional design factors, limiting their direct applicability to the English Language Teaching context. Similarly, reviews of discussion forum metrics (2025) highlight the need for standardized quality measures in online education, noting that while there are various analytical methods, social media analytics, cognitive metrics, AI-assisted grading, few have been validated against actual learning outcomes.

#### *Quality of Interactions for Learning Outcomes*

In a complementary qualitative study, Mojtahedzadeh et al. (2024) analyzed student interviews to understand the perceived quality of interactions in e-learning. Students emphasized that meaningful exchanges, responsiveness, and clarity were more important than mere frequency of interactions. Contextual factors, such as digital literacy and guided instruction, shaped these experiences.

Similarly, Gasser (2025) conducted a quasi-experimental study to test an online small-group intervention in classroom literature discussion. Structured discussion tasks increased the depth of discussion and the quality of turns, reflecting how guided design can enhance interactions beyond superficial participation.

Empirical studies consistently link high-quality interactions to improved learning indicators. Rüdüsüli et al. (2024) used mixed methods to show that the quality of teacher-learner interactions correlated with cognitive and language outcomes in game-based learning environments, emphasizing the role of depth and responsiveness. In higher education and online learning, Mojtahedzadeh (2024) found that students valued timely, practical feedback and opportunities to contribute meaningfully in online learning environments. Similarly, Gasser (2025) demonstrated experimentally that structured literary interventions can improve interaction and responsiveness, although the short duration of the intervention raises questions about transfer to long-term language proficiency. Vinokic et al. (2024) tested the thin-slice technique,

using short observational segments to assess interaction quality. Their findings suggest that thin slices reliably capture some aspects of interaction quality and are particularly useful for large-scale observations. However, validating these methods in English Language Teaching and other formal learning contexts remains a challenge.

Interaction quality refers to the depth, richness, and meaningfulness of communication between learners and instructors or among peers. In recent studies, ICT integration has emerged as a key determinant of interaction quality, not only through its presence in the classroom but also through the quality of its implementation. Consoli et al. (2025) emphasize that integrating technology that supports personalized instruction, cognitive activation, and effective classroom management significantly enhances students' behavioral engagement and attention span. Their study, which surveyed over 2,200 Swiss secondary school students, found that perceived quality of ICT use was more predictive of interaction outcomes than frequency of technology use, suggesting that superficial or poorly structured technology adoption does not naturally increase interaction quality. This finding is consistent with Tabassum et al. (2024), who reported that educational technology positively influences students' cognitive and emotional engagement when it is intentionally integrated into learning activities, supporting structured interaction opportunities and active participation.

#### ***Active and Collaborative Learning Engagement***

Extending further on the psychological aspects of engagement, Zhang et al. (2025) used a mixed methods approach to link types of engagement with self-efficacy and performance. The study found that instructor feedback and peer support significantly predicted both self-efficacy and task performance, suggesting that social engagement acts as a bridge between engagement and achievement. Similarly, a phenomenological study (2024) of teacher-student interactions found that deep relational engagement fostered students' social and emotional development—essential foundations for sustained learning—although the study focused primarily on character education rather than linguistic or cognitive outcomes.

Empirical evidence also suggests a direct link between ICT integration and sustained interactional behaviors, such as persistence on tasks and willingness to engage in collaborative problem-solving. For example, Fung et al. (2025) observed interactions with AI-enabled multimodal robots in a classroom setting, finding that students demonstrated higher levels of focused attention and were more likely to initiate dialogue and negotiation with both peers and robotic agents. This shows that IT tools with adaptive or interactive feedback capabilities can enrich the quality of interaction by creating a dynamic and responsive learning environment.

#### ***Factors influencing the quality of interactions***

A broader systematic review by Meng et al. (2024) synthesized 25 studies on online learning effectiveness during the COVID-19 pandemic. This review found that the type of interaction,

particularly synchronous versus asynchronous communication and instructor presence, was a key moderator of effectiveness. However, many of the included studies relied heavily on self-reported data, raising concerns about validity. Similarly, Hu et al. (2025) conducted a meta-synthesis that found that motivation, digital literacy, and emotional regulation played a mediating role in how interactions translated into learning outcomes. These reviews reinforce the multifaceted nature of online engagement, while also calling for more rigorous causal designs.

Several studies highlight the role of IT environments in promoting richer peer-to-peer and teacher-student interactions. For example, Possaghi et al. (2025) explored the use of multimodal learning analytics dashboards in K-12 classrooms, finding that student engagement was more consistent when technology provided real-time feedback, supported tasks, and visual cues that encouraged participation. Similarly, Sung and Nathan (2025) found that in online collaborative tasks, IT integration enabled more frequent interaction periods, with students more willing to engage in extended problem-solving discussions when technology-supported tasks clearly defined roles, goals, and feedback channels.

IT integration also influenced various aspects of interaction. Mohammadi Zenouzagh et al. (2023) studied computer-mediated text and multimodal writing environments and found that technology platforms enabled both cognitive and social engagement. Students in environments that incorporated guided prompts, peer feedback tools, and collaborative writing spaces demonstrated higher-quality interactions, including increased questioning, clarification, and constructive feedback. These findings suggest that interaction quality is enhanced not only when ICT provides the means of communication, but also when it actively supports and structures interactions, allowing learners to engage meaningfully. In summary, the impact of ICT integration on interaction quality is strong but conditional. This positive effect is most evident when technology use is meaningfully structured, aligned with learning goals, and complemented by teacher competence and professional development. Quality-focused integration promotes sustained engagement, active participation, and meaningful peer and teacher-student interactions, affirming that ICT can serve as a powerful interaction facilitator when used strategically.

#### ***4.2 Discussion***

The literature review demonstrates that ICT integration has a profound impact on both interaction quality and multimodal interaction. First, interaction quality is improved when ICT provides structured opportunities for collaboration, feedback, and role differentiation (Consoli et al., 2025; Tabassum et al., 2024). Teachers' competencies and professional development contribute to mediating these outcomes, emphasizing that technology is not a replacement for pedagogy but a complement to professional instructional design (Possaghi et al., 2025).

Second, ICT integration enhances multimodal interaction by allowing learners to communicate and co-construct knowledge across verbal, visual, gestural, and digital channels. Immersive

technology, AI-enabled tools, and dashboards provide real-time adaptive feedback, enhance engagement, and support higher-order learning (Sung & Nathan, 2025; Zhao et al., 2024; Fung et al., 2025). Multimodal interaction contributes to the negotiation of meaning, demonstrating how technology facilitates deeper understanding and collaborative knowledge construction (Canals, 2023). The interaction between interaction quality is significant. These results highlight the importance of integrating ICT in enhancing interactivity in foreign language learning.

## 5. Conclusion

The study shows that ICT integration significantly affects interaction quality and multimodal engagement in the context of TA teaching. High-quality integration promotes meaningful interactions, sustained engagement, and collaborative learning, while technology-mediated multimodal engagement enhances communication, understanding, and co-construction of knowledge.

Effective IT integration depends on pedagogical alignment, teacher competence, task design, and infrastructure quality. Interaction quality and multimodal engagement are mutually reinforcing, interdependent outcomes that together enhance the learning experience. These findings emphasize that technology alone is not enough; its integration must be purposeful, structured, and supported by skilled educators.

Interaction quality is a key driver of learning outcomes at all levels of education. Evidence increasingly shows that depth, responsiveness, and meaningful engagement predict performance more reliably than frequency alone. While methodological innovations such as thin-slice analysis and automated measurements facilitate effective observation, validation in the context of English Language Teaching remains a priority. Future research should develop English Language Teaching-specific interaction quality measurement tools that incorporate long-term outcome measures and explore the interplay between teacher competence, pedagogical design, and learner engagement. By focusing on quality rather than quantity, educators and researchers can better tap the potential of interaction to improve language learning outcomes.

In summary, ICT integration is a powerful tool for creating rich educational interactions and multimodal engagement. When thoughtfully implemented, it enhances both individual and collaborative learning outcomes, supporting deeper understanding and meaningful engagement across multiple modalities.

## References

1. Al Mamun, M. A., Lawrie, G., & Wright, T. (2022). Exploration of learner-content interactions and learning approaches: The role of guided inquiry in the self-directed online environments. *Computers & Education*, 178, Article 104398. <https://doi.org/10.1016/j.compedu.2021.104398>
2. Az-Zahra, V. D., Sofendi, S., & Petrus, I. (2024). Improving English Language Teaching by Integrating Technology Instruction. *Journal of English Education* and *Teaching*, 8(3), 632–652. <https://doi.org/10.33369/jcet.8.3.632-652>
3. Canals, L. (2023). Multimodality and translanguaging in negotiation of meaning. *Studies in Second Language Learning and Teaching*, 13(3), 601–626. <https://doi.org/10.14746/ssllt.31128>
4. Consoli, T., Schmitz, M.-L., Antonietti, C., Gonon, P., & Cattaneo, A. (2025). Quality of technology integration matters: Positive associations with students' behavioral engagement and digital competencies for learning. *Education and Information Technologies*, 30(6), 7719–7752. <https://doi.org/10.1007/s10639-024-13118-8>
5. Fung, K. Y., Fung, K. C., Lui, T. L. R., et al. (2025). Exploring the impact of robot interaction on learning engagement: A comparative study of two multi-modal robots. *Smart Learning Environments*, 12, 12. <https://doi.org/10.1186/s40561-024-00362-1>
6. Gasser, L., Preisig, D., Frei, A., Dammert, Y., Egger, S., & Murphy, P. K. (2025). Effects of a literary intervention on interaction quality in small-group discussions in the upper elementary grades. *Learning and Instruction*, 95, 101996. <https://doi.org/10.1016/j.learninstruc.2024.101996>
7. Nopis, A., & Hashim, H. (2024). English teachers' acceptance towards the use of technology for language teaching: A systematic review (2021–2023). *International Journal of Academic Research in Progressive Education and Development*, 13(4), 2891–2909.
8. Hu, J., & Xiao, W. (2025). What are the influencing factors of online learning engagement? A systematic literature review. *Frontiers in Psychology*, 16, 1542652. <https://doi.org/10.3389/fpsyg.2025.1542652>
9. Jusslin, S., Korpinen, K., Lilja, N., Martin, R., Lehtinen Schnabel, J., & Anttila, E. (2022). Embodied learning and teaching approaches in language education: A mixed studies review. *Educational Research Review*, 37, 100480. <https://doi.org/10.1016/j.edurev.2022.100480>
10. Li, P., & Lan, Y. J. (2022). Digital language learning (DLL): Insights from behaviour, cognition, and the brain. *Cambridge Psychology of Language Learning*.
11. Mao, Y. (2024). Chinese students' online learning: A systematic review of experiences and interaction patterns. *European Journal of Open, Distance and E-Learning*.
12. Mayer, R. E., & Clark, R. C. (2016). *e-Learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning* (4th ed.). Wiley.
13. Meng, W., Yu, L., Liu, C., Pan, N., Pang, X., & Zhu, Y. (2024). A systematic review of the effectiveness of online learning in higher education during the COVID-19 pandemic period. *Frontiers in Education*, 8, Article 1334153. <https://doi.org/10.3389/feduc.2023.1334153>
14. MDPI. (2023). Multimodal communication and peer interaction during equation-solving sessions with and



- without tangible technologies. *Multimodal Technologies and Interaction*, 7(1), 6. <https://www.mdpi.com/2414-4088/7/1/6>
15. Mojtahedzadeh, R., Rahimi, M., & Pourhosein Gilakjani, A. (2024). Students' experiences of interpersonal interaction quality in e-learning: A qualitative descriptive study.
  16. Msafiri, M. M., Kangwa, D., & Cai, L. (2024). Integration of information and communication technology in secondary education for better learning: A systematic literature review. *Social Sciences & Humanities Open*, 10, 101203. <https://doi.org/10.1016/j.ssaho.2024.101203>
  17. Nurjanah, L., Cahyono, B. Y., Suryati, N., & Effendi, M. I. (2025). Integrating Technology in English Language Teaching: A Study on Teachers' Digital Competencies. *Didaktika: Jurnal Kependidikan*, 14 (3 Agustus), 5803-5814. <https://doi.org/10.58230/27454312.2073>
  18. Possaghi, I., Vesin, B., Zhang, F., Sharma, K., Knudsen, C., Bjerkum, H., & Papavlasopoulou, S. (2025). Integrating multi-modal learning analytics dashboards in K-12 education: Insights for enhancing orchestration and teacher decision-making. *Smart Learning Environments*, 12, 53. <https://doi.org/10.1186/s40561-025-00410-4>
  19. Salaberry, M. R. (2017). The influence of modality and interaction on second language acquisition in technology mediated environments. In *Technology and language education: A teacher's guide* (pp. 145–166). Routledge.
  20. Sharadgah, T. A., & Sa'di, R. A. (2022). A systematic review of research on the use of artificial intelligence in English language teaching and learning (2015–2021): What are the current effects? *Journal of Information Technology Education: Research*, 21, 337–377
  21. Shadiev, R., & Yang, M. (2020). Review of studies on technology-enhanced language learning and teaching. *Sustainability*, 12 (2), 524. <https://doi.org/10.3390/su12020524>
  22. Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning*, 2 (1), 3–10.
  23. Sung, A., & Nathan, R. (2025). Unraveling temporally entangled multimodal interactions: Investigating verbal and non-verbal contributions to collaborative construction of embodied math knowledge. *International Journal of Educational Technology in Higher Education*, 22(8). <https://doi.org/10.1186/s41239-025-00504-6>
  24. Tabassum, B., Abbas, Q., Latif, S., Nawaz Khan, M. H., & Lodhi, K. (2024). Exploring the influence of educational technology on student engagement. *Jahan-e-Tahqeeq*, 7 (2).
  25. Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.). Harvard University Press.
  26. Walkington, C., et al. (2024). Multimodal analysis for embodied technologies (MAET) and language learning affordances in shared AR/VR environments. *Journal of Interactive Learning Research*, 35(4), 287–310.
  27. Wang, Y., & Kabilan, M. K. (2024). *Integrating technology into English learning in higher education: a bibliometric analysis*. *Cogent Education*, 11(1), 2404201. <https://doi.org/10.1080/2331186X.2024.2404201>
  28. Wiranata, S., Nasrullah, N., & Asrimawati, I. F. (2024). *Investigating technology integration in English language instruction from 2018 to 2024: A systematic literature review*. *Journal of English Language Teaching and Learning (JETLE)*, 5(2), 146–158. <https://doi.org/10.18860/jetle.v5i2.26439>
  29. Yu, L.-T. (2022). The effect of videoconferencing on second-language learning: A meta-analysis. *Behavioural Sciences*, 12(6), 169. <https://doi.org/10.3390/bs12060169>
  30. Zhao, L., Yan, L., et al. (2024). From complexity to parsimony: Integrating latent class analysis to uncover multimodal learning patterns in collaborative learning. *arXiv*. <https://arxiv.org/abs/2411.15590>