

# SEAMLESS COLLABORATION IN DISTANCE LEARNING: EXPLORING THE ROLE OF AN EMBEDDED VIDEO-CONFERENCING-SYSTEM IN GROUP WORK

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## Abstract

Collaborative learning is a cornerstone of modern education, offering significant academic, social, and psychological benefits. However, effective group work in distance learning environments remains challenging, particularly when it comes to fostering seamless communication and collaboration. This study investigates the integration of an embedded video conferencing system within a collaborative writing platform to enhance group work in a distance learning context. Using a mixed-methods approach, we examined how students utilized the system and explored the communication dynamics and social interactions that emerged during collaborative tasks. Data were collected from 353 students enrolled in a bachelor's-level psychology course, who participated in group writing tasks using the platform. Results revealed that while the system was frequently used for task-oriented activities such as organizing group work and discussing course content, its adoption for social interactions was limited. Sentiment analysis of video conferences indicated a neutral to slightly positive tone. Among 4,646 coded utterances, mean sentiment polarity was 0.12 and subjectivity 0.05, confirming task-focused, neutral-to-positive discourse with highly objective discussions focused on academic tasks. These findings suggest that while the embedded system effectively supports task-focused collaboration, additional features may be needed to foster social engagement and interpersonal connections. The study highlights the importance of designing collaborative tools that balance academic functionality with social interaction, offering valuable insights for educators and developers aiming to optimize virtual learning environments. Future research should explore broader applications of the system across disciplines and investigate strategies to enhance user acceptance and engagement.

**Keywords:** *Video conferencing system, virtual collaboration, cooperative learning, distance learning, learning technology.*

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## 1. Introduction

Research has demonstrated that successful group work in educational settings achieves better learning outcomes compared to individual work (Tsay & Brady, 2010). For instance, solving group tasks has been proven to enhance social competencies by fostering a sense of community, easing group dynamics, building mutual understanding, and creating a support system. It also offers psychological benefits, such as reducing anxiety about collaboration, increasing self-esteem, and fostering positive attitudes toward peers and instructors. Academic benefits are significant, as collaborative learning enhances critical thinking skills, engages learners in the learning process, improves course outcomes, provides a more personalized and adaptable teaching approach, and increases motivation among learners (Laal & Ghodsi, 2012). Despite these advantages, students do not always cooperate effectively in collaborative learning or group work settings (Gillies, 2016). As a student, it is important to regularly interact with other group members to promote mutual understanding and address potential social issues (Laal & Ghodsi, 2012; Johnson et al., 1985). However, without the right support, this can easily be overlooked. This is particularly problematic in distance learning environments, where students do not meet in person. Therefore, it is important to provide students with multiple virtual communication channels so that they can communicate as naturally and seamlessly as they would in a traditional, face-to-face university setting.

At universities, external tools such as forums, wikis, Zoom, and others are frequently utilized (University of Jena, n.d.; University Computing Centre Heidelberg, 2025; University of Hohenheim, n.d.). While a variety of tools are often provided to facilitate communication, they are not always integrated into a single environment. This can require users to switch back and forth between different platforms. The

freedom for students to choose their own tools can sometimes lead to the exclusion of group members, as not everyone may be comfortable or familiar with the selected tools. Additionally, the effort required to coordinate and search for suitable tools can be significant and may disrupt the group's workflow (Grudin & Poltrock, 1989). Furthermore, as switching tools can disrupt the workflow and "zone" in which learners are most effective (Csikszentmihalyi et al., 2018), it can pull them out of this state and thereby negate the positive effect. Therefore, it is advisable to provide predefined tools to avoid such barriers. However, a potential drawback is that this approach may isolate the group from other collaborative activities, so it is important to consider whether students will accept these tools.

To assist students in successfully completing group work, various tools have been developed and implemented. For example, the collaborative writing platform developed by Burchart and Haake (2024) supports teachers in setting up and monitoring collaborative writing tasks performed by large numbers of student groups. Here, students collaboratively work on documents both, synchronously and asynchronously to solve a group task. The platform provides a shared workspace for each group, featuring a shared text editor, a text chat, and a comment function on the shared documents for asynchronous communication. To further support synchronous communication among group members, this shared workspace (Burchart & Haake, 2024) has been expanded to include a video conferencing system named T<sup>3</sup> (Kasakowskij & Haake, 2025). This system is embedded within the collaborative writing platform, eliminating barriers such as additional logins or switching to third-party tools. It also provides features such as generating transcripts of group discussions, session summaries, and summary cards to facilitate reflection on conversations. The tool offers a wide range of options for asynchronous and synchronous collaboration and communication. However, it is unclear how students will use and accept such an all-round collaboration tool. Therefore the following research questions were formulated:

RQ1: How do students utilize the embedded video conference system in the collaborative writing task?

RQ2: What communication dynamics and social interactions emerge among students when using the embedded video conference system during collaborative tasks?

## 2. Method

For the study, a bachelor's-level psychology course in winter term 2024 which took place from October 1st, 2024 to December 31st, 2024 was selected. Participants volunteered to use a Moodle (Moodle HQ, 2025) Learning Management System (LMS) equipped with the collaborative writing platform (Burchart & Haake, 2024) as well as the embedded video conferencing system and agreed to participate in the study by signing a consent form. The study was approved in advance by the university's data protection officer. Students were informed about the use and handling of their data, and only anonymized data was used for analysis.

### 2.1. Study environment

A required group writing task structured the course. Students were assigned to groups of eight, each with a dedicated shared workspace containing a text editor, chat, and an embedded video conferencing system that automatically started a session when multiple members were present. The course unfolded in three phases:

**Phase 1** (Preparation): Teachers configured the task, formed groups, and defined instructions and materials. A plug-in then automatically created the virtual group workspaces.

**Phase 2** (Collaborative Writing): Students collaborated on writing and peer review within their workspace. Teachers monitored interactions and provided feedback via the integrated system.

**Phase 3** (Assessment): Teachers graded the final products and provided summative feedback. Formative feedback and analysis of group dynamics were supported by data collected throughout the process.

This phased design provided a scalable, integrated framework for collaboration, monitoring, and assessment.

### 2.2. Data collection & analyzation

A voluntary online survey, accessible from December 16, 2024, to January 19, 2024, was used to gauge perceived system quality and acceptance. Participants responded to items on 7-point Likert scales, and results were analyzed using the median and interquartile range (IQR).

The survey design was based on TAM (Davis, 1989) and the Information Service Evaluation (ISE) model (Schumann & Stock, 2014), which holistically evaluates information services across five dimensions. This study concentrated on Dimension 3, Information Acceptance, evaluating aspects like system usage, adaptation, and influence.

To analyze the subjectivity and polarity of sentiments expressed during video conferences, audio streams were transmitted to a server in real-time while the system was in use. The server utilized OpenData's Whisper (Radford et al., 2023) and Voice Activity Detection (VAD) (Silero Team, 2021) functions to segment the audio streams and transcribe them into text fragments. Each speaker's audio stream was processed individually. The transcribed text fragments were reconstructed into complete sentences and statements, with a pause of more than 10 seconds used to demarcate the end of a statement. Finally, the reconstructed statements were analyzed for sentiment polarity and subjectivity using the Python Natural Language Processing (NLP) package TextBlob (Loria, 2018). This approach allowed for a systematic evaluation of the emotional tone and subjective content of the discussions.

### 3. Results

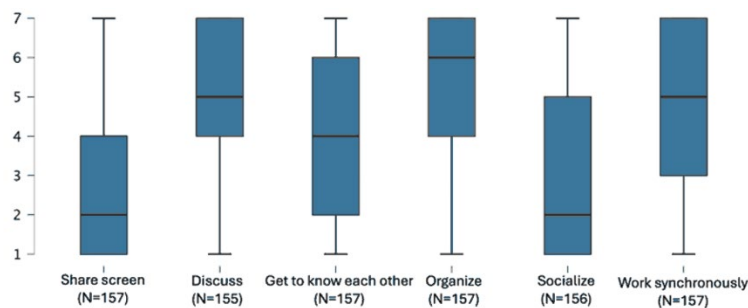
A total of 353 students from 102 working groups took part in the survey. The data collected demonstrated excellent internal consistency, as indicated by a Cronbach's alpha value of  $\alpha > 0.9$ . 84% (N=267) of the students were female, 15% (N=49) male and 1% (N=4) non-binary.

#### 3.1. Online survey

The frequency of system usage varied significantly among participants. A majority of students (n = 187) reported that they never used the system. A smaller but notable group (n = 101) indicated using the system approximately once a month, while 36 students reported using it several times a month. Only 20 students stated that they used the system once a week, and a single student reported using it several times a week with their group.

Figure 1 illustrates the diverse ways in which students used and adapted the service. The system was rarely used for screen sharing, with a median score of 2 and an interquartile range (IQR) of 3, and for socializing within the group, with a median of 2 and an IQR of 4. It was occasionally used for getting to know each other within the group, with a median of 4 and an IQR of 4. In contrast, the system was frequently used for discussing course content, with a median of 5 and an IQR of 3, and for working synchronously on group tasks, with a median of 5 and an IQR of 4. The system was most often used for organizing group work, with a median of 6 and an IQR of 3.

Figure 1. Use and adaptation of the service.



#### 3.2. Communication dynamics & social interactions

Over the course of the study, 253 students participated in at least one group session using the video conferencing tool and contributed verbal input. This resulted in a total of 4,646 statements, which were subsequently analyzed for sentiment using the Python NLP package TextBlob (Loria, 2018).

Figure 2. Subjectivity.

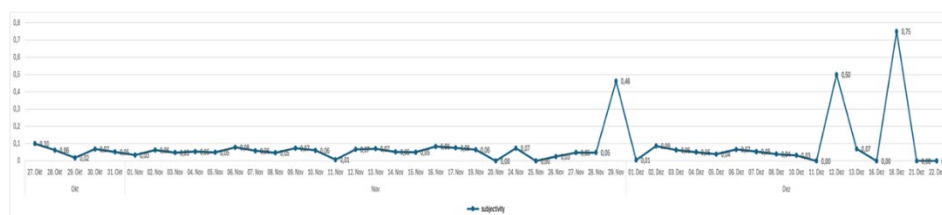


Figure 2 illustrates the measured average subjectivity values of all conversations per day. The values range between 0 and 1, where 0 indicates high objectivity and 1 indicates high subjectivity. As shown, the values remained consistently low throughout the study period, with only three outliers observed

on November 29, December 12, and December 18. Notably, the subjectivity values did not exceed 0.1 on most days, indicating a very low level of subjectivity in the discussions. Overall, the conversations exhibited a mean subjectivity value of 0.05, reflecting a highly objective tone.

Figure 3. Sentiment.

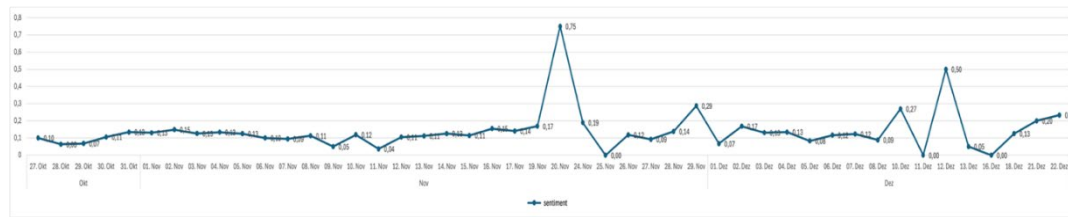


Figure 3 displays the measured average sentiment polarity values of all conversations per day. The values range between -1 and 1, where -1 indicates highly negative sentiment and 1 indicates highly positive sentiment. As depicted, the polarity values remained predominantly between 0 and 0.3 throughout the study period, with no negative mean polarities observed. Two outliers with higher sentiment polarity were noted on November 20 and December 12. On average, daily conversations among students were neutral to slightly positive. Overall, the conversations exhibited a mean sentiment polarity of 0.12, indicating a generally neutral to mildly positive tone.

#### 4. Discussion & conclusion

The findings of this study provide valuable insights into the utilization and acceptance of an embedded video conferencing system within a collaborative writing platform in a distance learning environment. The results highlight both the potential benefits and challenges associated with integrating synchronous communication tools into virtual learning spaces.

- *Utilization of the Embedded Video Conferencing System (RQ1)*

The survey results revealed a mixed pattern of system usage among students. While a significant majority ( $n = 187$ ) reported never using the system, a notable subset of students ( $n = 158$ ) engaged with it regularly, particularly for task-oriented activities such as organizing group work (median = 6, IQR = 3) and discussing course content (median = 5, IQR = 3). This suggests that the system was most effective when aligned with specific academic tasks, rather than for social or informal interactions. The low usage for screen sharing (median = 2, IQR = 3) and socializing (median = 2, IQR = 4) further underscores the importance of designing tools that cater to the functional needs of students in collaborative learning environments. Low adoption may stem from unfamiliarity, a preference for external tools (e.g., Zoom), or perceived limitations in flexibility despite integrated access. This aligns with research stating technology adoption depends on ease of use, workflow compatibility, and user preferences (Al-Ahdal et al.; Grudin & Poltrock, 1989).

- *Communication Dynamics and Social Interactions (RQ2)*

Sentiment and subjectivity analysis showed a neutral to slightly positive tone (mean polarity=0.12, mean subjectivity=0.05), confirming use for objective, task-focused communication, not social or emotional discourse. This matches survey data and underscores the need to foster both task and social interactions for group cohesion and learning outcomes (Laal & Ghodsi, 2012; Johnson et al., 1985). Future systems could add features like virtual breakout rooms to encourage informal interaction.

The study highlights the need for tools addressing both academic and social dimensions. While integration reduced technical barriers, acceptance was limited by perceived utility and user preferences. To improve adoption, designers could add customizable features, real-time feedback mechanisms (e.g., session summaries), and elements to boost engagement such as gamification (Pura, 2022), AI-enhanced interfaces (Rajaram et al., 2024), or social community-building features (Porwol et al., 2022; Manuel, 2022). As the ISE model notes (Schumann & Stock, 2014), service quality depends on interconnected dimensions like user characteristics and the information environment, warranting further study.

Limitations include potential selection bias from voluntary surveys, and limited generalizability due to a single-course focus. Reliance on self-reported data and automated sentiment analysis may miss nuances; future work should use qualitative methods (e.g., interviews) across multiple disciplines.

In conclusion, this study demonstrates the potential of embedded video conferencing systems to support collaborative learning in distance education, particularly for task-oriented activities. However, mixed usage and limited social engagement call for more nuanced design. By addressing the functional and social needs of students, fostering a supportive information environment, and continuously evaluating and

refining the system based on user feedback, educators and designers can create more effective and engaging collaborative learning experiences. Future research should build on these findings to explore additional dimensions of technology acceptance and identify strategies for enhancing the adoption and impact of collaborative learning tools in diverse educational contexts.

## References

- Al-Ahdal, A. A. M., & Abdulghani A. A. (2014). Assessing Teachers' and Students' Perceptions About Teaching and Learning Using Videoconferencing Method of Instruction. *Academic Research International*, 5(1), 111.
- Burchart, M., & Haake, J. M. (2024). Supporting collaborative writing tasks in large-scale distance education. *IEEE Transactions on Learning Technologies*, 17, 1051-1068.
- Csikszentmihalyi, M., Montijo, M. N., & Mouton, A. R. (2018). Flow theory: Optimizing elite performance in the creative realm. In *APA handbook of giftedness and talent* (pp. 215–229). doi:10.1037/0000038-014
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340.
- Gillies, R. M. (2016). Cooperative learning: Review of research and practice. *Australian Journal of Teacher Education (Online)*, 41(3), 39-54.
- Grudin, J., & Poltrock, S. E. (1989, March). User interface design in large corporations: coordination and communication across disciplines. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 197-203).
- Johnson, R. T., Johnson, D. W., & Stanne, M. B. (1985). Effects of cooperative, competitive, and individualistic goal structures on computer-assisted instruction. *Journal of educational psychology*, 77(6), 668-677.
- Kasakowskij, T., & Haake, J. M. (2025). T<sup>3</sup> Talk2Text – A model for near real-time voice transcription in virtual group meetings. *Discover Education*, 4(146). <https://doi.org/10.1007/s44217-025-00568-6>
- Laal, M., & Ghodsi, S. M. (2012). Benefits of collaborative learning. *Procedia-social and behavioral sciences*, 31, 486-490.
- Loria, S. (2018). *textblob Documentation*. Release 0.15, 2.
- Manuel, M. B. (2022). *An Examination of Presence and Engagement in Video Conferencing Systems and Virtual Environments* (Doctoral dissertation, Virginia Tech).
- Moodle HQ. 2025. *Moodle* (Version 4.1). <https://moodle.org>
- Porwol, L., Metcalf, S. S., Morrison, J. B., Chun, D. A., & Luna-Reyes, L. F. (2022). Facilitating virtual conferences: reflections and lessons learned in two global communities. *Digital Government: Research and Practice*, 3(1), 1-12.
- Pura, J. J. (2022). Linking motivation and employee engagement through gamification in remote working. *International Journal of Academe and Industry Research*, 3(1), 52-69.
- Radford, A., Kim, J. W., Xu, T., Brockman, G., McLeavey, C., & Sutskever, I. (2023, July). Robust speech recognition via large-scale weak supervision. *International conference on machine learning* (pp. 28492-28518). PMLR.
- Rajaram, S., Numan, N., Kumaravel, B. T., Marquardt, N., & Wilson, A. D. (2024). BlendScape: Enabling End-User Customization of Video-Conferencing Environments through Generative AI. *Proceedings of the 37th Annual ACM Symposium on User Interface Software and Technology* (pp. 1-19).
- Schumann, L., & Stock, W. G. (2014). The information service evaluation (ISE) model. *arXiv preprint arXiv:1407.4831*
- Silero Team (2021). *Silero VAD: pre-trained enterprise-grade voice activity detector (VAD), number detector and language classifier*. <https://github.com/snakers4/silero-vad>
- Tsay, M., & Brady, M. (2010). A case study of cooperative learning and communication pedagogy: Does working in teams make a difference? *Journal of the Scholarship of Teaching and Learning*, 10(2), 78-89.
- University of Hohenheim. (n.d.). *Going digital quickly - online teaching and working: Communication, Information and Media Center (KIM)*. <https://kim.uni-hohenheim.de/en/going-digital-quickly>
- University of Jena. (n.d.). Digital Tools for Your Studies. *E-learning*. <https://www.elearning.uni-jena.de/en/2574/digital-tools-for-your-studies>
- University Computing Centre Heidelberg. (n.d.). Service Catalogue. *Collaboration and Digital Teaching - University Computing Centre Heidelberg*. <https://www.urz.uni-heidelberg.de/en/service-catalogue/collaboration-and-digital-teaching>