# Teacher Communication Competence and Knowledge in Hybrid Learning Environments

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*Hybrid learning environments (HLEs), combining in-person and online participation, create dual-layered complexity that challenges teachers' communication practices. This study examines the essential knowledge and skills required for effective communication in HLEs within a Swedish higher education context. Drawing on the extended TPACK framework (XTPACK), emphasising immediate contextual knowledge, and integrating Jakobson's communication model, the research analyses how teachers mobilise technological, pedagogical, content, and dual contextual knowledge to bridge room and screen participation. An ethnographic study of an eight-week hybrid pedagogy course across four semesters combined teacher field notes, participant evaluations, and iterative AI-assisted and researcher-led analysis. Findings show that while participants emphasise technological aspects, communication emerges as core teacher competence. Effective hybrid teaching requires simultaneous management of parallel contexts, strategic channels and code usage, and adaptive stress regulation. The study conceptualises hybrid teaching as communication-based XTPACK in action, contributing to a deeper understanding of teacher expertise in hybrid higher education.*

*Keywords: hybrid teaching, higher education, teacher communication competence, XTPACK*

## Introduction

A learning environment comprises the psychological, social, cultural, and physical conditions in which learning occurs (Rusticus et al., 2023). Hybrid learning environments (HLEs) extend this ecosystem beyond the physical classroom by combining in-person and synchronous online participation (Bonk & Graham, 2006; Ellis & Goodyear, 2016; O'Byrne & Pytash, 2015), allowing students or teachers to attend the class synchronously from either the same room or online. While the broader literature sometimes uses "blended learning" to describe combinations of online and face-to-face components, blended formats involve asynchronous separation rather than parallel participation. To ensure terminological clarity, the term HLE will be used consistently throughout this paper to refer to synchronous dual-modality teaching contexts.

HLEs are generally well appreciated by students in higher education because they cater for the needs of flexibility in geographical location (Fructuoso et al., 2022) as well as some students' need to choose the physical classroom (Kee et al., 2024). It demands a teacher with competencies to reduce the distance between the two learning environments, virtual/screen and physical/room. This study focuses on the teacher's experiences while hybrid teaching, with the purpose of exploring the competencies used to handle the context of HLE.

In a higher education institution, combining "room participants" and "screen participants" is a significant challenge for the teacher who needs to put into practice all his/her technological, pedagogical and content-related knowledge, constantly juggling between in praesentia and online students.
While prior research has examined hybrid learning in terms of technological design and instructional organisation (Bonk & Graham, 2006; Imms & Kvan, 2021), less attention has been paid to the communicative practices required to address simultaneous in-person and online learners. This study approaches hybrid teaching through a communication lens to better understand teacher expertise in dual participation contexts.

The current research is focusing on defining the most important elements that teachers need to know for delivering a successful HLE course. The research question (RQ) approached is: **What are the essential knowledge and skills teachers need for effective communication in hybrid learning environments?**

For analytical purposes, the RQ is broken down into 3 sub-questions:

> Q1: What types of content, pedagogical, technological and contextual knowledge are most important for teachers to communicate effectively in hybrid settings?

> Q2: How do teachers mobilise channels, codes, and contextual awareness to sustain engagement across dual participation spaces?

> Q3: Which specific communication and technological skills enable teachers to overcome challenges unique to hybrid learning environments?

# Theoretical framework

## Hybrid Learning as a Design Challenge

Hybrid learning environments (HLEs) have been present in higher education for over two decades (Graham, 2006) and expanded after the pandemic due to their flexibility and adaptability (See et al., 2026). They combine face-to-face and synchronous online participation within the same instructional session (Bonk & Graham, 2006; Ellis & Goodyear, 2016). Research identifies challenges, including unequal participation, divided teacher attention, technological fragility, and increased cognitive load (O'Byrne & Pytash, 2015). Remote learners may experience reduced social presence, while teachers report stress when managing parallel instructional spaces. Much of the literature frames HLEs primarily as technological and spatial design challenges, focusing on infrastructure, participation equity, and organisational constraints (Zhong & Rosli, 2025).

## TPACK Model and Contextual Knowledge in Hybrid Setting

Hybrid learning environments rely heavily on technological infrastructures, raising questions about effective technology integration in teaching. The Technological Pedagogical Content Knowledge (TPACK) framework conceptualises teacher expertise as the integration of content (CK), pedagogy (PK), and technology (TK) (Koehler et al., 2014). Subsequent developments emphasise contextual knowledge (XK), highlighting that technology integration is shaped by institutional and situational factors (Mishra, 2019; Brianza et al., 2024). Context can be understood at distal (societal), proximal (institutional), and immediate (classroom) levels.
This study focuses on immediate contextual knowledge, as hybrid teaching requires teachers to respond simultaneously to in-person and online participation conditions. In HLEs, immediate context becomes dual: teachers must manage parallel physical and digital spaces, each with distinct communicative and technological demands. Figure 1 illustrates this dual-faceted immediate context within the XTPACK framework.

Figure 1
*Adaptation of XTPACK (Brianza, 2022) illustrating an HLE double-faceted context*
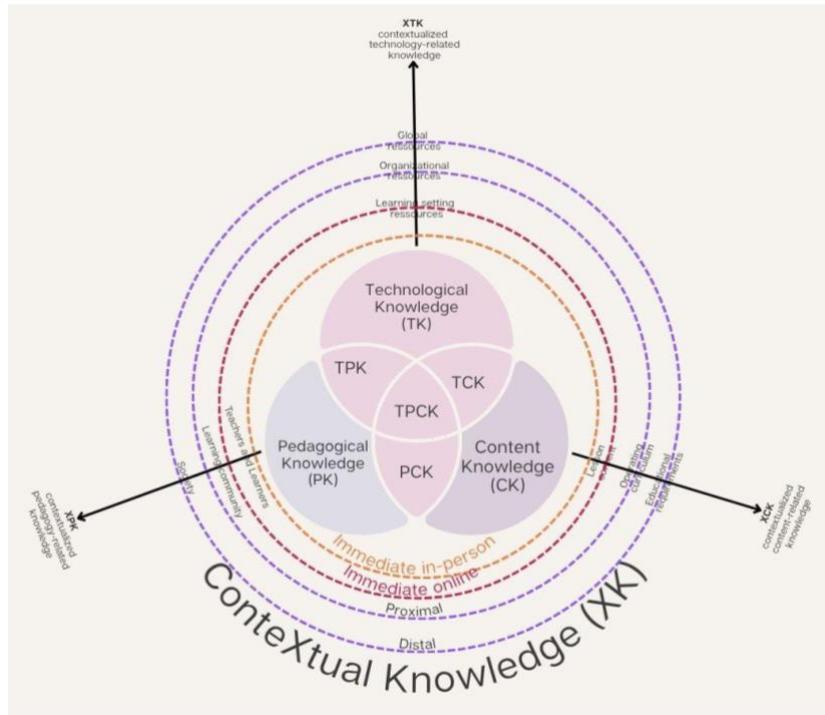


## Communication in Educational Contexts

The educational act is more than just context overlapped by pedagogical, technological and content knowledge. All courses (face-to-face/online), are primarily transmission of content and skills, thus a communication act.

Roman Jakobson defined the communication model as involving an addresser sending a message to an addressee, through a specific channel, in a certain context and using a certain code, as illustrated in FIGURE 2 below:

Figure 2
*Roman Jakobson's communication model (Jakobson, 1987)*

| ADDRESSER | CONTEXT MESSAGE CONTACT CODE | ADDRESSEE |
|---|---|---|

To establish the essential knowledge and skills teachers need for effective communication in HLE, an overlap between the two frameworks is proposed in the current paper and detailed below.

## The Missing Link: Communication in Hybrid Environments

As mentioned above, research on HLEs expanded in recent years. Current studies examine mainly HLEs technological infrastructures, classroom design, participation equity, and organisational implementation challenges. These perspectives advanced understanding of hybrid formats as spatial and technological configurations, but they tend to see hybrid learning mainly as a structural arrangement rather than as a communicative phenomenon.

The XTPACK framework brings a valuable lens for understanding the knowledge domains teachers must mobilise when integrating technology. It describes categories of knowledge rather than the real-time communicative processes through which the knowledge is put into practice. Similarly, classical communication models explain how messages are structured through channels, codes, and contexts, but they assume relatively unified communicative spaces, which is not the case with HLEs.

Teachers in HLEs must simultaneously address co-present and on-screen learners, manage multiple communication channels, interpret parallel feedback streams, and reduce psychological distance across spatial divides. This creates what could be described as a condition of "dual immediacy", where communication functions across two partially distinct but interdependent contexts: immediate in-person and immediate online contexts.

Despite the recognition of technological and organisational challenges, little research has been conducted on how teachers enact communication practices that sustain coherence, inclusion, and social presence across these dual spaces. The communicative dimension of hybrid teaching remains thus under-theorised. This study addresses this gap by integrating XTPACK with the communication theory, conceptualising hybrid teaching as communication-based knowledge in action. It investigates how teachers mobilise their technological, pedagogical, content, and contextual knowledge to reduce communicative distance between room and screen participants.

# Methodology

## Research Context

The current research was led by two experts: one with a solid background in educational research who focused on the theoretical approach, and the second, with over fifteen years of experience in online higher education teaching, specialised in the field of academic development, who delivered the course, gathered, and coded the ethnographic data. Data analysis and interpretation was made collaboratively by both researchers.

The study was conducted in a Swedish university where newly employed teachers complete an eight-week hybrid pedagogy course.The majority of participants are working full-time and don't get any hours for taking the courses, thus the need of offering a hybrid course where they could attend no matter the physical space they find themselves at that specific time.

One of these pedagogical courses, a 8-week long hybrid "Introduction to Higher Education Teaching and Learning" offered the context for this current study that was conducted from fall semester 2023 until spring semester 2025. The purpose was to observe and collect data on the pedagogical challenges and choices of the teacher in the studied context. With the teacher in focus, reflective notes were taken before and after each session, and these notes offered important data for analysis. Thus, it was a self-reflective observation with a focus on pedagogy and communication. As illustrated in Table 1 below, a total of 88 students were enrolled in the course, and the majority successfully completed it.

Table 1
*Number of participants per semester and completion rates for the course*

| Semester | Participants n=88 | Course completion | Learning environment | Participants'voluntary course evaluation (n=47) |
|---|---|---|---|---|
| F23 | 23 | 23 | B2 213 + Zoom | ca 7,0 of 10 |
| S24 | 23 | 21 (22) | B2 213 + Zoom | 4,3-4,6 of 5 |
| F24 | 22 | 22 | A2 311 + Zoom | 4,6-5,0 of 5 |
| S25 | 20 | 20 | A2 311 + Zoom | 4,3-4,6 of 5 |

**Research Method**

An ethnographic approach was adopted to examine teacher communication in situ, drawing on participant observation and reflective field notes. Ethnography was selected because it enables the study of teacher communication in real practice, capturing tacit knowledge and contextual adaptation that are difficult to access through surveys or experimental designs.

One of the current paper authors had the observer role in ethnographic research. Being an employee of the Swedish university and also a teacher of the hybrid course. Immersion into the higher education institution culture was thus total, and data collection easier. It is, though, important to distinguish between reflective observations recorded in the teacher's field notes and analytical interpretations developed by the research team. When statements derive directly from the teacher's journal, they are presented as teacher data. Broader inferences and theoretical integrations are made by the authors during the analytic synthesis phases.

**Research Data**

The data gathered consists of the hybrid course teacher's field notes (teacher data) and the regular course evaluation questionnaires completed by 47 of the 88 participants (student data), collected and analysed in Swedish and partially translated for publication purposes.

The evaluation questionnaires (participants' data) were given in Swedish, and only the quotes used as examples in the current paper were translated into English. Anonymous evaluation questionnaires are included in a regular, voluntary routine at the end of every course in the Swedish university where the study took place. Research participants accessed the ten questions, which included six multiple-choice and four open-ended questions, via the LMS Canvas. The course evaluations are usually used by the university to confirm participant satisfaction with the quality of the courses, but this time they were also used as primary research data for the current paper. Participants were informed during each course implementation that anonymised data will be collected during the span of the course and that they could inform the teacher if they wanted to prevent their contributions from being included in the research following the course implementation.

**Data Analysis**

All data was analysed in several stages, combining AI usage with content and thematic analysis. AI tools were used as exploratory support during the initial coding phases to enhance transparency and analytical breadth. However, all interpretations, thematic decisions, and theoretical integrations remained under researcher control, consistent with ethnographic principles of reflexive and context-sensitive analysis (Humble & Mozelius, 2022; Neuendorf, 2018; Nowell et al., 2017). Rather than replacing qualitative interpretation, AI-assisted coding functioned as a complementary tool within a researcher-led analytic process:

Table 2
*Logical Progression of Analytical Rounds*

| Round | Analytical focus | Who conducted the analysis | Question | Data used |
|:-----:|:-----------------|:--------------------------:|:--------:|:---------:|
| 1 | Initial identification of communication skills | AI | Q1 | student teacher |
| 2 | Identification of communication practices | Researcher | Q1 | student teacher |
| 3 | Re-coding through XTPACK & Jakobson communication model | Researcher | Q2 | student teacher |
| 4 | Mapping of communication skills to pedagogical frameworks | AI + Researcher | Q2 | teacher |
| 5 | Identification of hybrid-specific challenges | Researcher | Q3 | student teacher |

| 6 | Integrative synthesis answering the main research question | Researcher | RQ | student teacher |
|---|---|---|---|---|

Six rounds of analysis were conducted sequentially to refine the focus towards the main research question. The first two generated exploratory categorisations of communication practices from teacher and participant data. The third and fourth reinterpreted these findings through the XTPACK and communication-theory lenses, identifying possible relationships between knowledge domains and communicative strategies. The fifth examined how these practices addressed challenges specific to HLEs: the dual immediate contexts and the technological stress. The final round synthesised the previous ones to directly answer the main research question.

# Results

Several analytic rounds involved AI-supported exploratory coding. In these phases, Perplexity AI tool was used to generate preliminary thematic clusters based on structured prompts. These outputs functioned as analytic scaffolds and were subsequently reviewed, refined, and theoretically interpreted by the researchers. Thus, AI-assisted coding supported—but did not replace—researcher-led qualitative analysis.

## Round 1 of the Analysis Process

Perplexity AI tool was used to gather first insights into the data. The researchers' analysis of the participants' data started with this prompt: "Summarize and categorize all content that is connected to communicative skills in the uploaded document".

Table 3
*Perplexity AI "Fig.1." illustrating the Participants data analysis results*

| Communication skills | Examples | |
|---|---|---|
| Group Discussions and Dialogue | Group discussions worked well in smaller online groups. | Interaction was possible despite Zoom-based setting |
| Peer-to-Peer Exchange and Collaboration | Rich learning experiences from meeting colleagues physically and virtually | Exchanging perspectives across different fields was described as rewarding |
| Adaptability in Communication | Technical breakdowns (like Zoom rooms closing) did not hinder communication significantly; participants showed acceptance and adaptability | |
| Interactivity and Reflective Communication | Hybrid setting allowed both active dialogue and deeper reflection, which strengthened learning outcomes. | |

Table 3 presents the preliminary categorisation of communication-related content derived from participant evaluation data. Using a traditional content analysis approach in Round 2, the observation was made that AI results were focusing mainly on positive aspects. Participants also described challenges associated with the hybrid format. Some reported that mixing in-room and online group discussions created difficulties in turn-taking and coordination, noting that due to material conditions of face-to-face and Zoom interaction being so different "turn-taking/who-talks-when becomes very tricky" (anonymous participant). Others highlighted that online discussion is "not the same as discussing in real life" (anonymous participant) as certain communicative cues are lost. At the same time, participants acknowledged the flexibility of being

able to participate from any location as a positive aspect of the hybrid format.

The teacher data was initiated by the researchers in this first round also with Perplexity, using the prompt: "Mark every sentence where the teacher uses communication skills in the uploaded document". It generated as results: a row of examples where the teacher used communication skills and a follow-up question from Perplexity AI: "Do you want me to now create a condensed list of "communication skills demonstrated". This generated the following table as a result:

Table 4
*Perplexity AI "Fig.2." illustrating the Teacher data analysis*

| Communication skills | Examples | | |
|---|---|---|---|
| Welcoming & Building Rapport | Greeting remote participants by name | Asking them to unmute and test microphones(creates immediate engagement and comfort) | |
| Managing Turn-Taking & Visibility | Structuring introductions so remote participants speak first | Highlighting speakers on the big screen (ensuring equal presence). | Asking participants to hand over the floor themselves (shared responsibility for dialogue). |
| Clear Communication of Expectations | Stating that webcams are mandatory for remote learners (to support turn-taking and non-verbal cues). | Explaining the rationale behind this rule (good communication and inclusion). | |
| Inclusivity & Equal Participation | Practicing "positive discrimination" by spotlighting remote participants' comments and faces. | Directing initial questions to remote participants before in-room participants. | Using names deliberately to include individuals in discussions. |
| Engagement & Interaction | Actively pulling remote participants into group and large discussions by asking for their input. | Encouraging shared emotional reactions (laughter, surprise) across both physical and virtual spaces. | Designing tasks that motivate meaningful group work. |
| Nonverbal & Environmental Communication | Rearranging classroom furniture to encourage equal participation between remote and in-person groups. | Using screen placement to integrate remote participants visually in seminars. | Keeping a low profile in small seminars to allow peer-led communication to flow. |
| Clarity & Stability in Presence | Remaining present in the classroom during group work (providing stability and reassurance). | Turning off microphones during breaks and group tasks (removing distracting background noise). | |
| Feedback Recognition & Responsiveness | Acknowledging participants' appreciation for clear | Adjusting strategies (headsets, logging into | |

| | | | |
|---|---|---|---|
| | directives. | Zoom individually, spotlighting, etc.) based on learner feedback. | |
| Monitoring & Accountability | Watching breakout rooms to ensure active engagement (camera/mic on, no silent disengagement). | | |
| Striving for Seamless Integration | Continuously working to reduce the psychological and communicative distance between remote and in-room learners. | Articulating a clear pedagogical vision of "seamless" hybrid communication. | |

Table 4 summarises communication practices identified in the teacher's field notes during the exploratory coding phase. In Round 2, the teacher's field notes also revealed tensions associated with hybrid delivery. The expansion of the classroom into a digital arena generated a perceived "loss of control", as the teacher found it more difficult to observe, adjust, and manage interaction across parallel spaces. The notes further describe how background noise and spatial dynamics in the physical classroom negatively affected online participants, prompting immediate adjustments such as repositioning sound absorbers to improve audio conditions. These reflections illustrate both the destabilising effects of hybrid complexity and the need for continuous situational adaptation, all negative elements that weren't pointed out by the AI analysis.

**Round 2 of the Analysis Process**

Following the AI analysis, a more structured content and thematic analysis (Humble & Mozelius, 2022; Neuendorf, 2018) was conducted by the researchers on the gathered data through the lens of the XTPACK theoretical framework. The research sub-question was at this stage: What types of content, pedagogical, technological and contextual knowledge are most important for teachers to communicate effectively in hybrid settings? The color-coded occurrences were gathered in Figure 3 table and summarised in Figure 4.

Figure 3
*Counting the number of occurrences*

| Category | Occurrence total | Participants | Teacher |
|---|---|---|---|
| Technology | 86 | 66 | 20 |
| Pedagogy | 48 | 32 | 16 |
| ConteXt | 75 | 58 | 17 |
| Communication | 36 | 10 | 26 |
| Content knowledge | 6 | 4 | 2 |

Figure 4
*Number of coded categories and occurrences in the data*
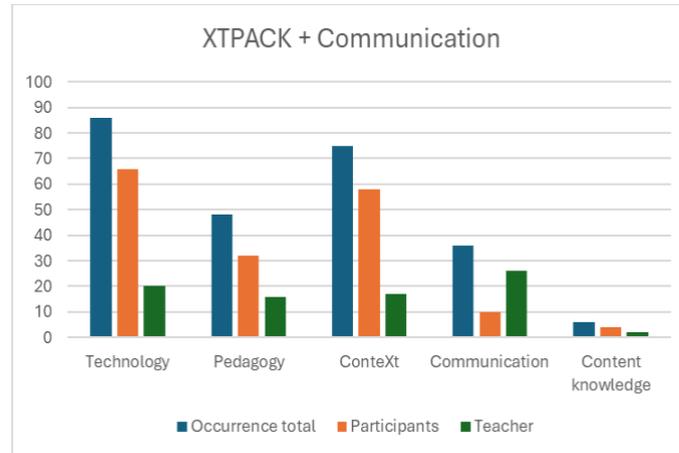


They illustrate that overall Technology is the main perceived issue in an HLE. Participants are mostly concerned by it (66 occurrences) rather than the teacher (20 occurrences). For the teacher, communication is the main problem of the HLE. Content knowledge, on the other hand, is less present both in students' and teacher's comments. Interestingly enough, there are differences in the frequency of Pedagogical and Context knowledge as students mention it more often (32, 58 occurences) than the teacher (16, 17 occurrences).

**Round 3 of the Analysis Process**

When examining the technical, pedagogical, content, and contextual codes generated in the previous round, recurrent patterns emerged that could not be fully explained through XTPACK alone. Many coded excerpts referred implicitly to elements central to communication theory, such as channel selection (Zoom vs. in-room audio), code negotiation (rules for webcam use, turn-taking norms), and contextual adaptation (managing parallel in-person and online spaces). This prompted a new round of analysis structured explicitly around Jakobson's communication model. The guiding sub-question for this phase was: How do teachers mobilise channels, codes, and contextual awareness to sustain engagement across dual participation spaces?

Re-coding the data through this lens revealed that communicative choices were inseparable from pedagogical intentions. Communication strategies are not only logistical adjustments but are tightly connected with the pedagogical approaches enacted in the hybrid setting. This indicates that teacher communication in HLEs operates as pedagogy in action rather than as a separate functional layer.

**Round 4 of the Analysis Process**

The fourth round of analysis deepened the analysis, beginning with PerplexityAI. Following the prompt "Map the communication skills (Fig. 2 above) to established pedagogical frameworks/pedagogical practices," it generated the table below. The communication skills referenced in this prompt were those extracted from the teacher's field notes in Round 2, rather than from participant data, as this phase focused specifically on analysing teacher practice in relation to pedagogical theory. Subsequently, the authors critically reviewed, refined, and validated these mappings to ensure conceptual coherence with the XTPACK framework and relevant pedagogical literature. Thus, the final table below represents an AI-assisted but researcher-verified interpretive synthesis rather than an automated or unexamined output.

Table 5

*Table mapping communication skills and pedagogical frameworks generated by Perplexity AI and researcher-verified*

| Communication Skill | Pedagogical Framework/Practice | Connection & Rationale |
|---|---|---|
| Welcoming & Building Rapport | Interpersonal Communication Competence | Greeting by name and checking microphones builds trust, immediacy, and rapport. |
| Managing Turn-Taking & Visibility | Collaborative Learning; Universal Design for Learning (UDL) | Inclusive turn-taking structures support equal participation and accessibility. |
| Clear Communication of Expectations | Transparent Teaching; Classroom Management | Stating rules (e.g., webcam use) and explaining why sets clear norms, fairness. |
| Inclusivity & Equal Participation | Inclusive Pedagogy; Social Presence Theory | Spotlighting and addressing remote participants counters marginalization/exclusion. |
| Engagement & Interaction | Active Learning; Dialogue-Based Teaching | Actively soliciting input and designing group tasks fosters engagement and agency. |
| Nonverbal & Environmental Communication | Classroom Ecology; Spatial Pedagogy | Rearranging physical layout creates psychologically safe and equitable spaces. |
| Clarity & Stability in Presence | Instructor Presence (Community of Inquiry model) | Being present and available enhances perceived instructor support and reliability. |
| Feedback Recognition & Responsiveness | Reflective Teaching; Formative Feedback | Acknowledging learners' needs and adapting practice signals responsive teaching. |
| Monitoring & Accountability | Classroom Management; Online Facilitation | Monitoring participation assures accountability and sustains group cohesion. |
| Striving for Seamless Integration | Hybrid Learning Best Practice; Social Presence Theory | Reducing barriers between modalities promotes a sense of community and connection. |

Table 5 maps identified communication practices to pedagogical frameworks, illustrating their theoretical grounding.

**Round 5 of the Analysis Process**

The fifth round focused on the third research sub-question: Which specific communication and technological skills enable teachers to overcome challenges unique to hybrid learning environments? The following excerpt illustrates how spatial design and technological orchestration supported communicative coherence across participation modes:

> *The design of the room has fostered interaction and engagement, while the hybrid solution in Zoom has enabled seamless communication between participants on-site and online. This has created an inclusive and dynamic learning environment where everyone has been able to contribute and take part in the discussions in an effective way.* (anonymous participant).

This reflection highlights how XK and deliberate integration of digital tools enhanced inclusive interaction.

In contrast, the following teacher reflection illustrates how technological uncertainty disrupted communication:

> *I hadn't got the technology going in the hall, the ceiling microphone and the small cameras that are attached to each group. When my colleague asked afterwards if I had received help from the AV technician to get started in the room, I answered Yes, but that was not true. I only plugged in my laptop, shared my screen at the front but ignored all other technology because I didn't think it would be absolutely necessary since we were running through zoom.* (teacher)

Here, cognitive strain limited the effective mobilisation of technological and contextual knowledge, negatively affecting communicative flow.

**Round 6 of the Analysis Process**

Finally, all data were grouped and analysed by the authors through the lens of the main research question: What are the essential knowledge and skills teachers need for effective communication in hybrid learning environments? This analysis brought up that: The course worked well when the teacher wasn't stressed by the HLE:

> *I spotlighted (in Zoom) the participant who was talking and it worked very well on the big screen I thought. Participants in the room saw and heard each one introduce themselves. There was also a camera in the room so they could see participants on site. We used a puck for the audio and I could adjust the volume when a zoom participant had a very quiet voice, as well as tell them that they needed to turn up their volume for next time.* (teacher)

This excerpt illustrates how confident orchestration of technological and communicative elements supported balanced interaction across dual contexts. Reduced cognitive strain enabled effective mobilisation of pedagogical and technological knowledge. The gap between room- and screen participants can be filled in through technology, communication and XK:

> *The final seminars worked very well and there was at least one participant on screen at each seminar (four in total). The purpose of these seminars is for the participants to read through their logbook entries and select one or two questions/ideas to raise for discussion in the seminar group. There is usually a warm and generous atmosphere between the participants at these seminars when we run a campus course and there was no difference now because we used the huge screen in the A2 330 and I had furnished with a table microphone right in front of the screen and my laptop camera pointed at the round table and the participants on site. When a Zoom participant was going to present their thoughts, I put a Spotlight on the participant so that their picture was in focus on the big screen in Zoom. It created a closeness between the participants regardless of physical or virtual presence.* (teacher)

This example illustrates how the perceived gap between room and screen participants can be mitigated through the integrated use of technological tools, communication strategies, and XK. The teacher's deliberate positioning of cameras, microphones, and screen displays demonstrates contextual awareness of both physical and digital spaces, while spotlighting Zoom participants functioned as a communicative strategy to equalize visibility and presence. Rather than relying on technology alone, the orchestration of spatial arrangement and interactional norms fostered a shared sense of closeness, suggesting that effective hybrid integration emerges from communication enacted through XTPACK knowledge in practice.

Teacher's communication skills combined with XTPACK knowledge is the key for successful HLE:

> *The final seminar was what crowned the course. An excellent opportunity where we as participants can devote ourselves to comparisons, connections, contrasts, problem solving, support and idea formation in light of our different experiences. The teacher's silent competence is an invaluable asset that is in place when needed and never fails. Here, the zoom integration worked excellently by rearranging the room.* (anonymous participant)

This excerpt, for example, illustrates how effective hybrid teaching depends on the integration of communication competence with technological, pedagogical, and contextual knowledge. The participant's reference to "silent competence" reflects the teacher's ability to orchestrate interaction across dual spaces without drawing attention to the underlying complexity. The successful Zoom integration and spatial reconfiguration demonstrate XTPACK knowledge enacted communicatively, supporting seamless engagement in the hybrid environment.

## Discussion

When confronted with an HLE, the teacher finds himself/herself in a double-faceted immediate context. By including both room and screen participants in the communication model, the teacher has to juggle with different TPACK domains and two types of addresses, coming from the in-person and online spaces. This leads to the imperative of the teacher to be simultaneously aware and have knowledge of both immediate in-person and immediate online contexts.

As illustrated in the Figure 5 below, in an HLE, the teacher acts as the addresser from Jakobson's communication model who must communicate to two addresses simultaneously. He needs, thus, first of all Content Knowledge as it is this one which will give the message. But for the message to be effectively delivered, the teacher needs to choose an appropriate code and channel.

As Figure 3 illustrates it, communication is the main concern of the teacher and effective communication in an HLE can be done through accessing Pedagogical and Technological Knowledge. If the second one ensures the communication channel, the first gives the communication code. But mastering them comes through countless experimentations and overcoming cognitive stress due to technical failures: "I hadn't got the technology going in the hall, the ceiling microphone and the small cameras that are attached to each group. When my colleague asked afterwards if I had received help from the AV technician to get started in the room, I answered *Yes, but that was not true* (teacher). It is a trial and error process generating finally (*The final seminar was what crowned the course.*- anonymous participant) that *hybrid learning best practice* (Table 5) that creates *closeness between the participants regardless of physical or virtual presence* (teacher).

Table 5 shows thoroughly that, in an HLE there are a multitude of pedagogical approaches put in practice by the teacher. Aiming for seamless integration of all learners, the social presence theory is implemented alongside UDL, inclusive pedagogy, active learning, spatial pedagogy or dialogue-based teaching, reducing barriers between on-screen and face-to-face participants. The HLE teacher must thus be a pedagogy expert, ready to juggle with different approaches. But all these pedagogical approaches decisions are directly connected with continuously accessing the contextual knowledge, more specifically, the immediate context cues.

In fact, to ensure that both room and screen addressees receive and understand the message, the teacher has to access at the same time an Immediate room Context Knowledge and an Immediate screen Context Knowledge. This is essentially XTPACK in action through the communication model lens. But communication is bi-directional, and if the teacher/addresser interacts with the addressees, these ones reply back, which leads to the teacher having to decode and process two replies coming from two immediate contexts.

Figure 5
*Teacher's knowledge mobilized while communicating in an HLE*
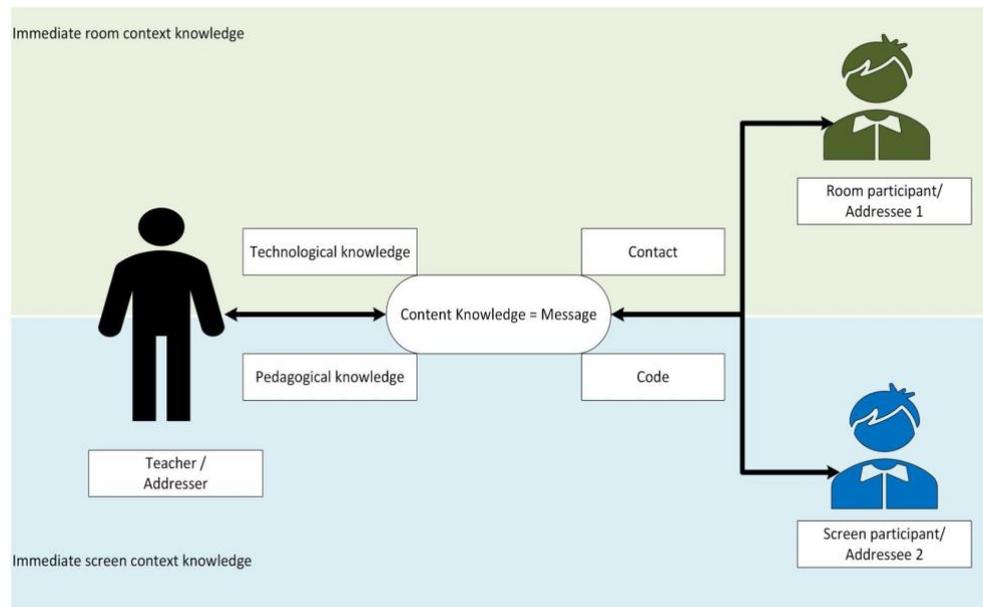


This communication-based XTPACK is highly demanding and difficult to master. The teacher involved in the current experimentation noted in the journal when reflecting on the whole experience: *I managed better than anticipated, but I was very exhausted until I got used to the new environment.* (teacher) Exhaustion is a direct result of the high stress level generated by such a complex communication situation.

But it is important to remember that the HLE is, in fact, a new type of learning environment. Teachers change learning environments on a daily basis when moving from one classroom to another and develop stress management skills over time that allow them to adapt to new immediate contexts. *The habit overcomes the stress eventually. But it's not for everyone.* (teacher)

In an HLE, the knowledge mobilised is multiple (technological, pedagogical, content and a double-faceted immediate context knowledge), but communication and stress management skills development are the keys to success.

## Conclusion

HLEs impose on the teacher a series of prerequisite knowledge and skills. Communication is essential, as the teacher confronted with HLEs must juggle between two immediate contexts: the in-person and online, facilitating communication between and with both room and screen participants. He must apply his technological knowledge, communication skills, and develop stress management strategies to cope with this new type of learning environment.

This opens doors to new investigations that will identify the techniques for teachers to adapt to HLE lesson delivery.

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