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THE "FERNSTUDENT". ENHANCING THE POTENTIAL OF HYBRID TEACHING BASED ON USER-CENTERED DESIGN

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ABSTRACT

Hybrid teaching has become a common approach, with its inclusive character being a main advantage. However, it also comes with problems such as increased attention requirements for teachers and a lacking social integration of both groups of students (remote, on-site). The present research aims to enhance the potential of hybrid teaching through innovative technology concepts that leverage the advantages while minimizing the disadvantages from a technical and experiential perspective. Based on a literature analysis and empirical insights from explorative interviews with teachers and students, we introduce the concept of the Fernstudent. It gives remote students a physical presence in the classroom, in the form of an anthropomorphic robot that sits in a row with the other students, transmits images and sound from the lecture hall, and can also signal to join the discussion. Retrospective interviews with teachers after nine-week field tests revealed that it could provide the main envisioned benefits but also showed points for further development. Limitations of the present research and more general implications for research and practice are discussed.

KEYWORDS

Hybrid Teaching, Cognitive and Social Demands, Remote Students, Robot, Social Interaction, Fernstudent

1. VISION AND RESEARCH GOALS: ENHANCING THE POTENTIAL OF HYBRID TEACHING

A university classroom after the summer break – the special teaching situation caused by the Covid-19 pandemic is over, and we can finally return to classroom teaching. As a teacher, you really enjoy standing in the classroom before your students again. You especially appreciate the livelier interaction and discussion with your students, which could unfortunately only take place on a rudimentary level during the virtual lectures. You enter the lecture hall on the day of the first lecture. About 100 students have registered and 70 of them are present. Actually, there are 71 seats occupied, but this additional student is no ordinary one: It is the "Fernstudent", a robot with a more or less anthropomorphic form, sitting in the second row. You have already heard about it: a robot that records the lecture via camera and makes it available for the virtually connected remote students, giving them a presence in the lecture hall at the same time. Integrated in its head, the Fernstudent has a large display on which the remote students are visible. You just start your lecture in the normal way, speaking to the students. "Well, let's see what you remember. Can any of you explain the idea of dissonance theory in the simplest possible terms?" Silence first. After a short period of consideration, the Fernstudent signals that a remote student wants to say something. You give her the floor, and, with the help of the integrated speakers, she speaks at a volume as if she were actually present in the room.

During the pandemic, hybrid formats of interaction have been tested more extensively and become more common in educational and other contexts. And even beyond the pandemic, hybrid teaching is alive and well. Students have come to expect it more, enjoying the flexibility to join lectures without spatial constraints. In the research literature, the term hybrid teaching is not used consistently. It is applied to different combinations of residential classroom and digital teaching, the integration of technology in learning

environments (e.g., Linder, 2017), in some cases also including asynchronous teaching via recorded lectures (Sing et al., 2021). The present research focuses on hybrid teaching as in the scenario described above, in the sense of a synchronous live session for present and remote students. This follows the definition by Ulla and Perales (2022, p. 2) of hybrid teaching as "synchronous teaching of students in the classroom and online simultaneously using an online platform", i.e., "an approach to teaching that not only integrates technology in the teaching process but also combines students who are inside a physical classroom and students from online". In this scenario, the teacher is faced with a dual audience: the physically present students and the remote students, each with specific options of interaction. In common practice, the remote students can follow the lecture via video and audio channel using an online platform (e.g., Zoom, Jitsi) and are given the chance to pose questions or comments via textual chat (hopefully recognized by the teacher).

Thus, in principle, there are three groups whose needs and interaction quality must be considered in hybrid teaching: Teachers, physically present students, and remote students. However, it shows that current approaches typically do not address the needs of these three groups in a satisfying way (e.g., Gamage et al., 2022; Ma et al., 2023). For the remote students, hybrid teaching mainly provides spatial flexibility, albeit at the cost of very limited participation or even complete exclusion from the interactive part. Consequently, they often remain passive, invisible consumers. For the teachers, it means the additional effort to keep an eye on a chat and to serve two worlds at the same time. In consequence, interaction takes place primarily between the onsite students and teacher whereas the last group often remains outside or generates a lot of effort.

The present research aims to enhance the potential of hybrid teaching through innovative adaptions of existing technology which exploit the advantages while minimizing the disadvantages. To meet this goal, we first identified central potentials and challenges in the current form of hybrid teaching reported in research in education and human-robot interaction (HRI) as well as explorative interviews with teachers and students, addressing cognitive and social issues. Based on these insights, we developed the concept of the "Fernstudent" (German compound word, originally referring to students of a remote university), as briefly outlined in the introductory vision. A prototypical implementation and field test over a 9-week period provided insights into teacher's experiences and ideas for future improvements of the concept. Limitations of the present study and more general implications for hybrid teaching and next research steps are discussed.

2. RELATED RESEARCH IN EDUCATION AND HRI

2.1 Potentials and Challenges of Hybrid Teaching

The general advantages of hybrid teaching are unchallenged, with its inclusive properties as a main benefit. Persons who cannot be present in the physical classroom for any reason such as travelling, childcare, illness or infection risks, still have a chance to participate (e.g., Johannessen et al., 2022; Klunder et al., 2022; Newhart et al., 2016). Once this option is provided, other students might also make use of it, so that the ratio of remote and physically present students might change to 50:50, or remote students might even be the majority. However, as also known from digital teaching in general, typical challenges on the part of the remote students are a decrease in motivation, a feeling of loneliness, less interaction with the teaching staff and other students (Lorenzo-Lledo et al., 2021), and, connected to the lower engagement in discussions, less practice of active learning, critical thinking, and the ability to debate (Gamage et al., 2023).

The teachers also face challenges, as digital and hybrid teaching requires new cognitive and social skills. These range from the practical handling of the technology to developing new teaching styles. For example, due to a lack of implicit, non-verbal communication, teachers need to state expectations and information more clearly, it may be more difficult to check students' understanding of the subject matter and progress in their learning process, and they may have a harder time to capture remote students' attention (e.g., Huizinga et al., 2022; Gamage et al., 2023; Lorenzo-Lledo et al., 2021). Referring to hybrid teaching, a particular challenge is the split audience, i.e., two groups of students following the same lecture but with very different contexts and options. Even if they seek to distribute attention equally, teachers tend to focus on the larger group of students (Huizinga et al., 2022), and a real "blending" of the physical and digital classroom does not happen. In many cases, the focus of interaction remains in the physical classroom, whereas remote students are less present and less engaged. As also known from other types of hybrid meetings, remote participants

often feel neglected and uninvolved and cannot find the right timing or modality to join an intense local discussion (Ma et al., 2023). In theoretical models of student engagement (e.g., Fredricks et al., 2004) a sense of belonging is a central part of emotional engagement, which, in turn, affects performance. Also models of exploratory learning emphasize the key role of social interactions for developing knowledge (e.g., de Freitas & Neumann, 2009). Given this, the creation of a learning environment that connects remote students in an appropriate way emerges as a crucial factor of success for the future of hybrid teaching (also see Raes, 2022).

In sum, besides reducing the cognitive burdens for teachers, one of the central goals for the improvement of hybrid teaching is to create more intense connections between all three groups involved and to reduce the differences in social presence and interaction opportunities between remote and physically present students. Following the theory of transactional distance (Moore, 1993), a deciding factor for a satisfying learning experience is to reduce the psychological distance between student and teacher, student and student, and student and content (also see Gallon et al., 2019). Thus, the main challenge is to design hybrid learning in a way that is physically distant but psychologically close (also see Boye & Ayet, 2021).

2.2 Telepresence Robots and Similar Concepts

A first straightforward way to enhance the social presence of remote students in the classroom might be a physical representation through an anthropomorphic robot with microphone and loudspeaker, which naturally supports a style of interaction with a social entity. As well-documented by studies in HRI (e.g., Airenti, 2015; Araujo, 2018), we interact in a more "human" way (e.g., more politely) with anthropomorphic than with purely technical, non-anthropomorphic artifacts. Hence, just like the on-site students, the robot/remote student may have its place on a seat in the lecture hall and remote students can use their voice to join the discussion. Thereby, the people on-site hear the voice from the direction of the robot and not as a voice from the "off".

There is already wide experience with the use of telepresence robots (TPRs) in educational settings (e.g., Kwon et al., 2010; Virkus et al., 2023). A telepresence robot is typically a 1:1 representation of a remote person, meaning that one robot represents one person, usually displayed on a screen (for examples see https://telepresencerobots.com). Often, the remote person can operate the position of the robot and camera angle to control what he or she wishes to see (as opposed to needing someone to point a camera at a particular person or object). Previous applications of TPRs in educational settings are generally promising. A review of 28 studies about TPRs in education lends support for a better socialization, integration, and collaboration of remote students with their peers (Velinov et al., 2021). For example, TPRs for homebound school children helped these students to stay socially connected with their classmates and overcome feelings of isolation, while the anthropomorphic appearance helped the on-site students to see the robot as an actual student and initiated talk about the person "coming back" (Newhart et al., 2016). At the same time, researchers emphasize that the acceptance of TPRs for wider use is still challenged (Virkus et al., 2023) and report audio problems as a typical issue (Velinov et al., 2021). Besides the classical TPR, exploratory design concepts address particular challenges of hybrid formats (e.g., Grønbæk et al., 2021; Ma et al., 2023). For example, the concept Snotbox (Ma et al., 2023) represents participants in hybrid meetings by small boxlike robots standing on the meeting table, while an automatic memory function activates a flashlight, signaling that remote members have not participated in the discussion for a certain period of time.

Compared to such concepts, the present approach is an adoption of the TPR idea tailored to a typical university lecture. Instead of a 1:1-representation, all remote students are represented by the same one physical entity placed at a fixed spot among the physically present students (which seems more practical and more affordable in typical university structures than multiple mobile devices). Just as with the TPR approach, the idea is to enhance the social presence of remote students (and reduce demands for the teaching person) by a physical representation of them. This provides options to communicate in a more natural way and in the same modality as the physically present students, with the ultimate goal to put both groups as much as possible on the same level.

3. EXPLORATIVE INTERVIEWS

In order to gain deeper insights into the particular needs and experiences of the relevant groups in the context of hybrid teaching, we used explorative interviews as a typical method of requirements analysis in user-centered design (e.g. Lizenberger, 2023). Our main informants were two university teachers, namely, Peggy, 31 years, background in psychology and Tom, 44 years, background in media informatics (the names are pseudonyms). The interviews followed three leading questions, i.e., 1) What are your (positive and negative) experiences with hybrid teaching? 2) What are the advantages and specific qualities of face-to-face compared to hybrid teaching? 3) What should be changed to make hybrid teaching an (even) better option? Do you have any ideas on how technology could support this? Each interview lasted about 20-30 minutes. The interviews were transcribed verbatim, and statements were broadly categorized into recurring themes.

As an additional source of information, we used interviews with 57 students conducted in the context of a practical course on "Experience Design" as part of the Media Informatics Curriculum at our university, which revealed additional issues of relevance from a student perspective.

Table 1. Key issues and exemplary statements raised in the explorative interviews about hybrid teaching with teachers ([P] = Peggy, [T]=Tom) and students [S]

Hybrid teaching as one-directional communication, bad relationship, lacking energy
"Hybrid teaching is usually only a stream in one direction. Remote students don't participate, there is hardly any feedback and hardly any contributions. A bad relationship, because rarely something comes back." [T]
"In a classroom lecture, I have the feeling that I am giving something of myself – and then a lot of energy comes back from the students. With digital teaching: I feel that the energy I have given is sucked up by the screen and nothing comes back." [P]
Exhausting to manage, divides the teacher's attention
"You look in the chat all the time, but most of the time nothing is there. And if there is, you see it too late because the messages from chat don't pop up or ring clearly enough. A very tangible technical hurdle." [T]
"It divides my attention. I also have to be in two places at once." [P]
Bad compromise
"The fact that it is live actually creates more stress, but the advantage of being live is not exploited." [T]
"Having a hybrid option is good in principle, but in the current way it misses the mark. Many of the remote students use it to do other things in parallel, which leads to less attention and engagement." [P]
Split audience, motivational differences between students get more pronounced
"In theory you have two groups of students included. But the ones who are remote might as well be gone - whether one is watching or 50 or 100 is really meaningless. You are not connected to this group." [T]
"It divides the group a bit into the committed and the non-committed." [P]
Social space as main advantage of classroom teaching, energizing experience, better teaching quality
"The main advantage of classroom teaching is that it creates a social space. Compared to the digital, where you talk to fifty black screens - you are totally exposed but speaking to people you can't see." [T]
"When I look into the students' faces, this also brings me to new thoughts and the lecture gets an individual note and better quality." [P]
Bring both student groups on one level (in visibility, modality, social interaction, appearance in the room)
"You have to bring the invisible ones to the same level as the others. Also included in the social context." [T]
"There should be the same modality for all students. In social contexts it has become established to raise your hand. But the remote students can't do this. They could just interrupt and speak in. Not a good solution." [T]
"…and also of dimension. I don't need to see a three-meter-tall head of someone but also not only one point." [P]
Separate remote students from teacher's screen to make comments welcome (and not a disturbance)
"From my point of view, a big problem on the teacher's side is this change between presentation and conference tool, which is usually in the background. This could already be solved by a second notebook." [T]
"In the current way, when someone of the remote students wants to speak this has more the character of a disturbance than an enriching contribution. I would have to push my slides into the corner to make the video visible to the others. To be honest, I hope nobody of the people from the hybrid room wants to say something, because then I have to manage this technically. As sorry as I am." [P]
Difficulties in moderating discussions, lacking feeling of togetherness, two separate groups of students
"Questions from the plenary have to be repeated, questions from the chat have to be read out. A hard job for the teacher to somehow put the two separate spaces together." [S]
"It was difficult to create a feeling of togetherness in hybrid lectures." [S]
"In hybrid mode, discussions among students only arose within modalities. Verbal in the classroom, and in the chat among the remote students. You had two separate groups discussing different issues." [S]

Teachers seem overburdened, exclusion of questions from remote students "Professors seem totally overwhelmed to manage the technology and issues like sound problems etc." [S] "Some teachers even said that no questions from online classmates are allowed." [S]
Chat as a welcome opportunity, social inhibition "The professor should be considerate of the fact that it is not so easy for many students to participate who don't dare to speak before the others. The chat provides a good platform to ask questions relatively anonymously." [S] "I liked being able to ask online questions in the chat without interrupting the prof." [S] "The chat was a nice option to get really helpful advice without having to directly interrupt the lecture [no whispering]." [S]
Design ideas: loudspeaker for questions from remote students, camera that records on-site students "Questions from the remote students are played through a loudspeaker and the actively speaking students are then also shown on a display. There is no chat function to encourage more verbal exchange." [S] "Integrated camera for remote students that turns on when sound comes from presence audience so that remote students can see the on-site students during discussions." [S]

4. CONCEPT DEVELOPMENT AND KEY FEATURES

Based on the above insights from literature and explorative interviews, we defined the following key features of the Fernstudent concept:

- A physical avatar with a physical body represents the remote students
- It transmits image and sound from the lecture hall (via camera, microphone)
- It transmits image and sound of an interacting remote student into the lecture hall (via display, speaker)
- It transmits a (vague) idea of the number of remote students joining the lecture
- It can interact with the environment in the lecture hall in a rudimentary way, e.g., through "hand signals" (motor elements) or lights for signaling that one of the remote students wants to speak.

From an experiential point of view, these key features were defined to meet the following goals:

- Integrate remote students as seamlessly as possible into the situation of face-to-face teaching
- Place both student groups on a closer level (in visibility, modality, opportunities for social interaction)
- Make both student groups appear as one unity, receiving the same attention from teachers
- Reduce the burden for teachers of handling content and technology, provide more attention for students
- Improve the overall experience of hybrid teaching, e.g., teachers' feelings of competence

Regarding the technical realization, in its simplest form, the Fernstudent may consist of a simple physical shell, a notebook with camera and microphone, loudspeakers and, if necessary, a movable arm or a lamp for signaling the students. Likewise, existing conference software (e.g., Zoom) can be used for the first prototype, which covers the basic functionalities and at the same time is already familiar to all potential participants. A first functional prototype which can be used for field testing of the concept in teaching is therefore possible within a short time and with limited resources. Regarding the specific form and design, students of the practical course "Experience Design" experimented with different design variants. Figure 1 shows some examples of sketches and prototypes (for a more detailed description of the design variants and video prototypes see https://blockpraktikumexperiencedesign.wordpress.com). A combination of the different variants' characteristics resulted in a functional prototype, also used in the field test.

Figure 1. Design variants of the Fernstudent (Source: https://blockpraktikumexperiencedesign.wordpress.com)

5. PROTOTYPICAL IMPLEMENTATION AND FIELD TEST

Figure 2 shows the functional prototype of the Fernstudent in the lecture hall, featuring the following characteristics and functions:

- Its physical body is similar to human size. When it is "sitting" its head is on similar height as the physically present students.
- Its display shows the image of the remote students. If one of the remote students is speaking, it switches to this student and shows its picture in full screen size.
- The remote students see the combined picture of the beamer picture (i.e., the presentation slides) and the teacher, who is recorded by an HD zoom camera.
- It is equipped with a directional microphone with auto-adjust function. The remote students can hear the teacher and other students speaking.
- It is equipped with a loudspeaker. A remote student speaking can be heard throughout the whole lecture hall, by the teacher and other students as well.
- It features a signaling function for the remote students. If a remote student wants to say something. they press a report button on their interface, which activates an LED ring.
- It indicates the (vague) number of remote students with an LED matrix of randomly distributed LED lights. Each LED light represents one remote student. If more remote students are joining the lecture, the matrix gets more illuminated (if you would count the LEDs, you would have the exact number of remote students, but this exact number is mostly irrelevant).

Figure 2. Functional prototype of the Fernstudent in the lecture hall during the field test.

For a first field test, the Fernstudent was used in multiple sessions of two different lectures during the summer semester 2023 over a nine-week period, taught by the teachers who participated in the explorative interviews (Peggy and Tom). Lecture 1 was a bachelor's course on market and consumer psychology with 119 students (min=110, max=140) participating per session on average (avg. 49% remote students), taught by Peggy. Lecture 2 was a bachelor's course on user experience with 33 students (min=20, max=45) participating per session on average (avg. 23% remote students), taught by Tom. Both teachers had gained solid experience with conventional online and hybrid teaching during the pandemic. The study was approved by the institutional review board and informed consent was collected from all participants.

The Fernstudent and its basic features were introduced in the first test session. Just like in the previous sessions, students were free to decide whether they joined the lecture in presence or remotely. After each session, students and teachers filled in a questionnaire and rated their experience of the lecture with the Fernstudent by several measures and qualitative questions. In addition, retrospective in-depth interviews were conducted with the two teachers after the course had finished at the end of the semester. Basically, the interviews followed three leading questions, i.e., 1) How did you experience the teaching sessions with the Fernstudent? 2) What did it change compared to previous sessions of hybrid teaching? 3) Do you have any suggestions for improvements or further developments? Due to space limits, the present paper focuses on the teachers' perspective expressed in the interviews, which already provide interesting insights in the strength of the concept as well as issues for future research and development. Again, central issues are summarized in key sentences and illuminated by exemplary interview statements by Peggy [P] and Tom [T].

Table 2. Key issues and exemplary statements raised in the retrospective interviews after using the Fernstudent prototype in the field test by teachers ([P] = Peggy, [T]=Tom)

Overall pleasant and relaxed atmosphere, stress reduction, sense of competence
"All the stress of switching between background tasks and presentation view is gone. A very relaxed situation." [T]
"The remote students are just as present as the others and can draw attention by themselves. And these signals are so salient that you notice them automatically and don't have to look for them explicitly." [T]
"It also gives you a sense of competence. Finally, you can offer good hybrid teaching. Everybody expects that this is something that should be feasible - and now you can fulfill these expectations." [P]
Technology handling in the background, focus on content and students
"The technology and the handling was very much in the background." [T]
"No need for a special channel for the remote students. You could just see the faces and they could speak to you. I'm no longer in charge and actually another device takes care of it." [P]
Natural interaction, appropriate form, pleasant social interaction,
"Really a very nice experience. That you could address the student directly without having a special mic or anything. Very natural. You didn't feel like the technology was a hurdle, but really in the background." [T]
"You can perceive at first glance that this is supposed to represent a human - but it's also not so playful that you have to stare at it all the time. They are clear, simple shapes, and not distracting. So that the technology is not in the foreground but remains a vehicle to solve the problems of hybrid courses." [P]
Enhanced presence of remote students, blending of both groups of students, more like one category
"What I found amazingly positive was to permanently see how many remote students are there, maybe also coming or going. So you just had more of an impression of your audience and how many people you are actually talking to." [T]
"In the past, the remote students were more a kind of background category. You hardly could connect to them. Through the avatar in the lecture hall, the remote ones are just as visible as the present ones." [T]
"I realized that an integration of physical presence and non-presence is actually possible." [P]
Remote students still less active than physically present students
"Still, the remote students did not participate as much as the students who were physically present. Which of course can be a selection effect because those don't come who also don't want to participate so much. Or maybe someone is sick and then doesn't feel like much interaction." [T]
"The frequency of interaction among the remote students was not yet the same as among the on-site students. Maybe they first have to learn that it can be done differently. Just as it was a learning effect for me to see that this really works." [P]
Improve audio quality and visibility of remote students for physically present students
"The audio technology is something that could still be improved. Of course, the microphones have to be very sensitive, but you also hear every rustling paper." [T]
"The number of remote students should be more visible for all. So, for example, you can see that it's a well-attended lecture and that it doesn't have a demotivating effect if the physical lecture room is a bit emptier." [P]
Bonus ideas: record function, fly-in-perspective for remote students, support exploration
"If you already have such a tool that is adjusted so that lecturer image and slides are integrated, you could also easily integrate a recording function. That would be a nice bonus." [T]
"I guess you still could work on the experience for the remote students. For example, in computer games you often have a perspective flight at the beginning where you see yourself, your avatar, from above and then you fly into the body. Something like that could be built in at the beginning, when you dial into the meeting, that you then fly into the robot and then you change to the normal view and see the presentation slides and the lecturer." [T]
"It doesn't necessarily need any more features now but maybe a good intro tour at the beginning that everyone really understands the possibilities. Just like when you switch on a new iPhone, you get a few tips on what you can use. If you do not use it with all the features, you also do not experience the real advantage." [P]

6. CONCLUSION

The first field test of the Fernstudent prototype already showed very promising results. Realized by relatively simple technological means, it's functioning was stable and it became a normal element of hybrid lectures. More important, the teachers' reflections showed that it also fulfilled the envisioned experiential benefits: It reduced stress and cognitive demands for teachers and provided a more unified social interaction with and between on-site and remote students. Overall it enabled a more satisfying teaching experience that allowed the teachers to focus on the students' needs and not the technology. Although the functions it provides are relatively simple, the Fernstudent made a great difference.

Still, the present investigation is limited in several respects. The main contribution is the theoretically and empirically informed concept development. However, this still must be evaluated in more lectures, at different universities, with more diverse user groups, and include a stronger focus on the students' perspective. While full data-analysis is still ongoing, early results from the survey among students in context of the present field test show that also from the students' perspective, the Fernstudent did initiate some changes compared to the regular hybrid option based on Jitsi, such as higher perceived social presence of the remote students and the interaction between teacher and remote students was perceived more similar to that between teacher and on-site students. Also, remote students showed a higher intention for active participation in the Fernstudent compared to the Jitsi sessions, however, on-site students were still more active and raising their hand more often than remote students (as also reported by the teachers). Regarding the impression of the Fernstudent in the classroom, the most part of the on-site students described it as mainly neutral and neither particularly positive, nor negative. This generally accords to the intended effect of the Fernstudent, as giving the remote students a presence in the classroom but not becoming a character and source of attraction itself.

Besides, there are many options for further development of the concept, especially from the students' perspective. The "bonus ideas" mentioned in the retrospective interviews already provide some ideas (e.g., exploration tours, fly-in perspective, record function). However, note that additional features must be carefully explored, in order to not dilute the overall concept and protect its core functions. In addition, there are many elements of design which could be explored in more detail such as the adequate level of anthropomorphism, or choices of the material and shape to better meet the different requirements in daily use (e.g., acceptance, low weight for portability, robustness).

Moreover, apart from the specific case, this study presents a number of implications for future studies in educational research and learning psychology. Our research reveals how a generally promising concept of education (here: hybrid teaching) can be challenged by specific characteristics and constellations of cognitive, social and technological aspects, which impede the delivery of its full potential – and how a detailed analysis of key issues can help to resolve those. Furthermore, it would be interesting to explore learners' experiences with the Fernstudent from the perspective of theoretical frameworks, and to study how different components play together. For example, one interesting starting point would be the community of inquiry-model, originally developed in the context of (pure) online learning (Garrison, 2016), but later also applied to hybrid learning. The model lists three presences that help to stimulate a successful "Community of Inquiry" and optimal educational experiences, namely, social presence, teaching presence, and cognitive presence. For an evaluation study, it would be interesting to test how the Fernstudent performs with regards to the different presences, and which might be dominant.

Regarding practical applications, the concept of the Fernstudent might also be generalizable to other contexts. Telepresence is already a well-known phenomenon in other domains, for example at conferences, where, however, interactivity is usually not the focus. The present findings could be used to transfer the concept of telepresence to other application areas, such as hybrid meetings and technology-assisted learning in different contexts. This, of course, also requires future investments into developing a stable, transportable system at relatively low cost. Then it would be conceivable in the future to multiply the Fernstudent - similar to the video conferencing sets currently available in lecture hall technology - and to provide it out to teachers and researchers at all places. Conversely, it would also be conceivable to install the Fernstudent permanently in selected lecture halls, as a signal and mission statement: We are and will remain a face-to-face university, but we have leveraged the experiences from the pandemic and are using them to move us into the future.

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