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Space and Time in Hybrid Teaching and Learning Environments: Two Cases and Design Principles

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Abstract. The opportunities and challenges of teaching and learning in the same and different space and time have been discussed in the field of distance education for several decades. Within COVID-19, a new type of experimenting and research interest in so-called hybrid learning has emerged. In this article, we present the results from exploring "hybridity" from the perspective of classical categorizations of different forms of learning in terms of time and space. We explored the phenomenon through two cases with the same high-level strategic objective, serving hybrid interaction. In case A, we evaluated university library spaces renovated to serve hybrid teaching and learning. In case B, the focus was on the implementation of a university course redesigned during the pandemic from blended learning to include more hybrid interaction. Multifaceted data was collected, including video recordings (case A), recorded videoconference sessions, and written student feedback (case B). Qualitative data analyses relied on ethnography and contextual inquiry. Based on the analyses of the case studies, we propose five design principles for designing hybrid teaching and learning that aim to overcome the limitations of the same space and time: (1) Ensuring access to required tools, infrastructure, and support; (2) Design primarily for same time, different place learning; (3) Design primarily for same time, same place learning; (4) Less is more; and (5) "Le bon Dieu est dans le détail." These design principles provide guidance to the design process of hybrid teaching and learning to increase the chances of reaching a successful solution.

Keywords: Design Principles, Hybrid Teaching and Learning, Learning Environments

1   Introduction

With the COVID-19 pandemic, several concepts have gained popularity, as practitioners have tried to find ways to organize teaching and learning in the middle of the crisis. One of these is "hybrid," of which the aim is to enable teaching and learning in situations where some of the participants are unable to attend the classroom. Although in recent years, hybrid teaching and learning has been a buzzword, there is a relatively long history, especially in the field of distance learning, of defining possible best practices to overcome space and time restrictions.

During COVID-19, various ways of organizing teaching and learning in exceptional situations of lockdowns and restrictions were implemented. Concurrently, some of the practices designed in these times have made many practitioners ask if we should reconsider the entire existing paradigms of teaching and learning in ways similar to those discussed in relation to the future of work. If increasing remote working will be part of the "new normal" of work life, could remote teaching and learning also become part of mainstream practices?

In this article, we aim to open up the current research related to hybrid teaching and learning. We also present two real-life cases where the concept has been used. Based on the analyses, we present five design principles for hybrid teaching and learning environments, supporting particularly synchronous teaching and learning that occurs in different places. The design principles are guidelines aimed to help the design process and, thereby, increase the chances of reaching a successful solution.

In the following section, we start with a concept analysis of hybrid teaching and learning, and frame the phenomenon of interest. Then we continue with a brief introduction of the two cases with analyses. The results from the analyses are presented and discussed as five design principles for hybrid teaching and learning environments, where an essential part of teaching and learning is synchronous collaboration that takes place partly face-to-face and partly online.

2　Hybrid Teaching and Learning in Space and Time

To categorize different forms of learning, a matrix (Fig. 1) has been developed to present the dimensions of same and different spaces and times, depending on where and when the learning activities take place [1]. The upper-left area represents traditional teaching and learning, where teachers and students get together in the same space and time. The other three areas represent different kinds of distance learning with their own opportunities and challenges.
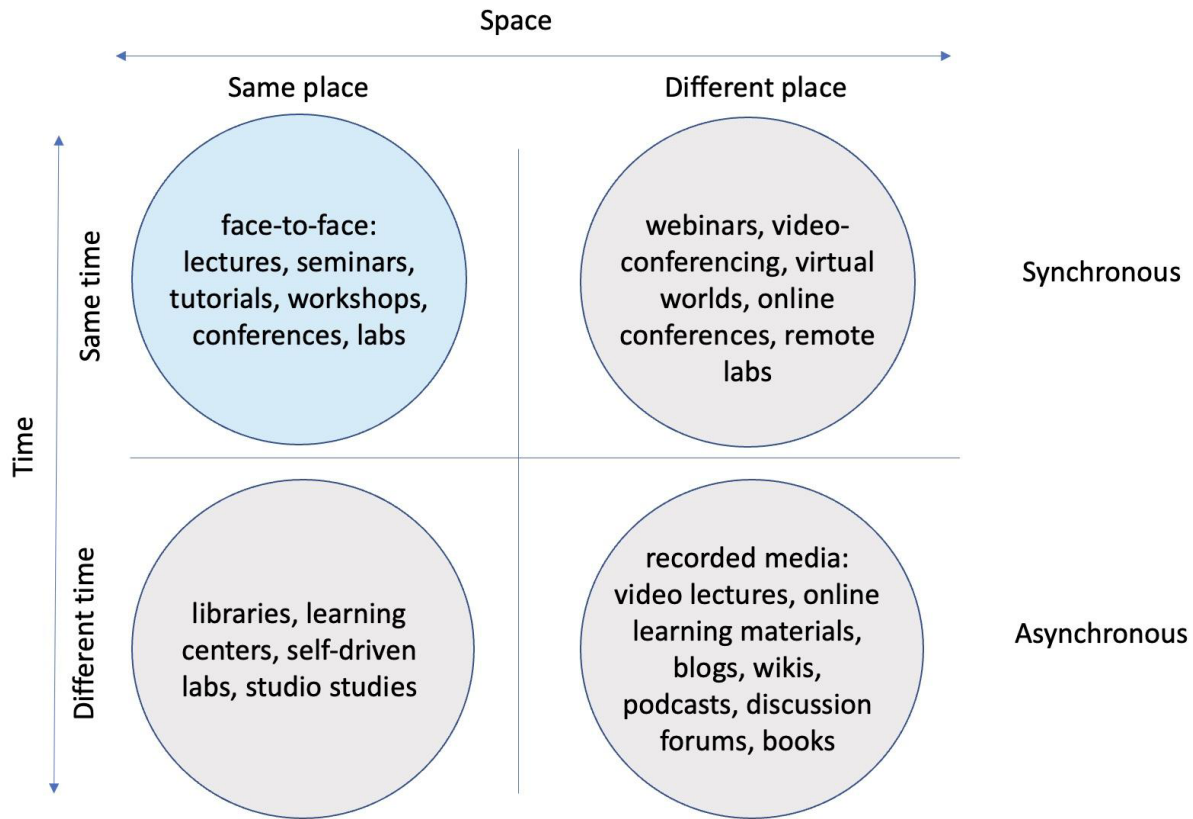
Space

	Same place	Different place	
Same time	face-to-face: lectures, seminars, tutorials, workshops, conferences, labs	webinars, video-conferencing, virtual worlds, online conferences, remote labs	Synchronous
Different time	libraries, learning centers, self-driven labs, studio studies	recorded media: video lectures, online learning materials, blogs, wikis, podcasts, discussion forums, books	Asynchronous

Time

Fig. 1. Shared space and time of participants in teaching and learning situations modified from the original by Miller [1].

Broadly speaking, the term "hybrid" can entail participation in multiple locations either synchronously or asynchronously. As a concept, it became popular during the COVID-19 pandemic and the growing need for remote meetings, teaching, and learning. Simultaneously, desktop videoconference solutions and the internet infrastructure had become mature enough to experiment with "hybrid meetings" and "hybrid teaching," whereby some participants are present in the same place while others attend the session via videoconferencing.

Before the pandemic, the term "hybrid" has been used in various educational contexts. For instance, authors such as Graham and Allen [2] use blended and hybrid learning environments as synonyms for learning environments that combine face-to-face teaching with technology-mediated remote teaching and studying. The term "blended learning" is commonly used in relation to practices where variations exist between the space and time where learning takes place [3, 4, 5]. However, hybrid teaching and learning in today's mainstream means that some participants may share the same time and place, while others participate at the same time but in different places. It may also consist of recordings for their posterior use. In practice, this means that participants have more freedom to choose their preferred study place and time. When we consider a hybrid teaching and learning environment, we are precisely interested in the educational arrangements as a whole, including variations in time and place, the physical and virtual spaces and tools

(i.e., technology-enhanced physical environments) , services, practices, and participants' activities and interactions (i.e., psychosocial environment) [6].

In the recent research literature, there are several more concepts related to hybrid teaching and learning. According to Irvine, Code, and Richards [7], in "multi-access learning," students are given opportunities to choose between synchronous online or onsite or asynchronous online modes of participation. As described by Elder [8], the "multi-options" teaching methodology allows students to choose weekly either onsite, synchronous online, or asynchronous online attendance at their convenience. He, Gajski, Farkas, and Warschauer [9] use the term "flexible hybrid instruction" as a model in which all course materials, including lecture videos, are offered online one week before class, and students are also given the freedom to choose whether to attend onsite classes or not. Bower, Kennedy, Dalgarno, Lee, and Kenney [10] describe "blended synchronous learning environments" as a model whereby some students participate in face-to-face classes through synchronous technologies such as videoconferencing and virtual worlds. A similar design is also applied in Bell, Sawaya, and Cain's [11] experiments, which they call "synchromodal classes".

Beatty [12] proposes a term "hybrid-flexible" (HyFlex) for learning environments in which students can flexibly choose to participate (1) in face-to-face synchronous sessions in-person (in a classroom), (2) in face-to-face synchronous sessions via videoconference, or (3) fully asynchronously via videos and other available online materials. Eyal and Gil [13], in turn, emphasize the fluidity of "hybrid," in the sense that it crosses boundaries between virtual and physical, formal, and informal. Also, Goodyear [14] highlights the importance of the students' role as active co-configurators of hybrid learning and spaces with "rich mixtures of material and digital tools and resources."

A recent systematic literature review on synchronous hybrid learning [15] concluded that most of the existing research is still exploratory and mostly describes students' experiences on a course in which both onsite and remote students participated in learning activities simultaneously. Earlier research also reports organizational and technological implementations. Thus far, research evidence on the advantages or disadvantages of hybrid teaching and learning is scant. Having online materials always available for students has been found to increase the time spent on learning and improve learning outcomes in blended learning [16]. For synchronous blended/hybrid learning, in particular, some studies highlight the greater educational access, increased student autonomy, and flexible choices that this mode offers [7, 10, 17]. Additionally, an enhanced sense of community and interchanges of experiences between campus students and, often, more professionally experienced online students have been reported [7, 10, 18]. However, a common challenge faced by teachers in this mode is dividing their attention between onsite and online participants [10, 18, 19]. Teachers also need to adapt their teaching methods and learning activities to the synchronous mode [11, 15].

We see that a need still exists for more explorative research to gain experiences from different implementations of hybrid teaching and learning. This means experimenting with existing courses by expanding them in the direction of hybrid teaching and learning, and considering what should be taken from these to establish permanent practices. We also see that hybrid teaching and learning needs a physical space. This means that schools, classrooms, and libraries need to be redesigned to facilitate hybrid interaction. In the following, we present two cases and analyses of them.

3   Case Studies

In these cases, the attempt was to design a hybrid teaching and learning environment. The cases are very different, but they share the same high-level strategic objective: being and serving hybrid interaction. Two independent case studies were conducted in two Finnish universities. The first case focuses on evaluating the potential of a newly renovated university library for hybrid teaching and learning. The focus is on the teachers' perspectives. The second case presents a university BA-level course that has been taught for a couple of years using a blended-learning approach, and in autumn 2021, it was quickly modified to include more online activities and, therefore, became hybrid interaction. In this case study, the focus is more on the students' perspectives.

3.1 Case Study with an Action Research Orientation

With the case studies, we aim to explore the phenomenon of hybrid teaching and learning, rather than answering any predefined research questions. Therefore, this research consists of two exploratory case studies to develop pertinent hypotheses [20] that are presented in the form of design principles. We have collected multifaceted data from the cases, including video recordings from test sessions (case A) and recorded videoconference sessions and written feedback from students (case B). In the qualitative data analysis, we have relied on ethnography and contextual inquiry as described in the context of design research [21, 22]. Its aim is to specify and develop a domain, which, in our case, is hybrid teaching and learning environments.

Both authors participated in the data analysis. Instead of transcribing entire video recordings, the researcher in charge of the particular case reviewed collected recordings by writing down notes that responded to our research aim [see 23]. The same procedure was followed with the written student feedback. In the data analysis, we followed an interpretative approach, focusing on significant (i.e., meaningful or relevant) themes and on identifying "clusters of meaning" about problem areas. Trustworthiness and credibility of the analysis was strengthened by cross-checking the initial themes identified by the researchers in each case. The design principles were finally derived from the themes that were identified in both cases. This was also thought to augment their transferability to different contexts.

The authors have been an essential part of the research, participating in the activities, facilitating the participants, observing, and taking notes during the cases, with the intention of recognizing challenges and looking for opportunities to solve them. Therefore, in this research, there is also an action research orientation, as applied in educational research. In educational action research, the aim is to conduct research that will result in improvements in educational practice [24].

3.2 Case A: From a Library to a Hybrid Teaching and Learning Space

In autumn 2021, a newly renovated library was opened at the University of Jyväskylä in Finland. The renovated library offers a spacious and multipurpose, interdisciplinary meeting point for all citizens. The aim is to be "hybrid," connecting formal, non-formal, and informal learning: an open entry point to research knowledge, and a meeting place of knowledge, learning, and wellbeing. The building is described as a science living room that draws people to scientific knowledge. The library entails an open science center (open science, library, and museum services), digital services, and student life center, promoting student wellbeing. There is also a café and a restaurant in the building. The library includes a number of teaching facilities equipped with the latest technology as well as two highly equipped studios for multimedia productions. There are various reading halls, group working spaces, and spaces for quiet work. There are also spaces for science and art education and exhibitions. The library is promoted as a venue for various events that can be easily streamed online. Public events of the University, such as doctoral dissertations, are streamed on a wall-sized screen in the café for a wider audience.

In January 2022, the adequacy of the library's multipurpose learning spaces and technologies for hybrid teaching and learning—recorded synchronous onsite and online sessions—were evaluated. The evaluation was conducted as part of the university's education development program ("JYULearn"), with the aim of involving the university community in the development of pedagogically and digitally relevant teaching practices, new kinds of learning opportunities, as well as structures to support multi-sited hybrid interaction. A researcher (author 2) and a coordinator invited a representative of the university's digital services to introduce the available technologies in the learning space. Technologies were then tested with four university teachers from the faculties of information technology, education, and humanities and social sciences. Two participated in testing onsite and two online via videoconferencing. The testing took three hours, and the sessions were video recorded for later analysis.

The multipurpose learning space where most of the testing took place (Fig. 2) entails reconfigurable furniture: tables and chairs that allow for individual and group configurations, sofa groups, and individual chairs with writing pads.

For presentations, chairs and tables can be arranged facing the wall where the presentation, which can also be shared with online participants, is displayed by means of a data projector. There is also a video camera on the ceiling that can be directed towards the presenter/s using a remote control. There are two wearable microphones for presenters and two handheld microphones that can be used by the onsite participants. The aim of the multiple microphones is to enable online participants to clearly hear the presentation. Audio speakers in the room make it possible for everyone in the space to hear the comments from the remote participants. Online participants' presentations can also be displayed on the screen. The space also includes a movable interactive whiteboard computer with a video camera, which can be used to display online participants and provide them with another view of the space.
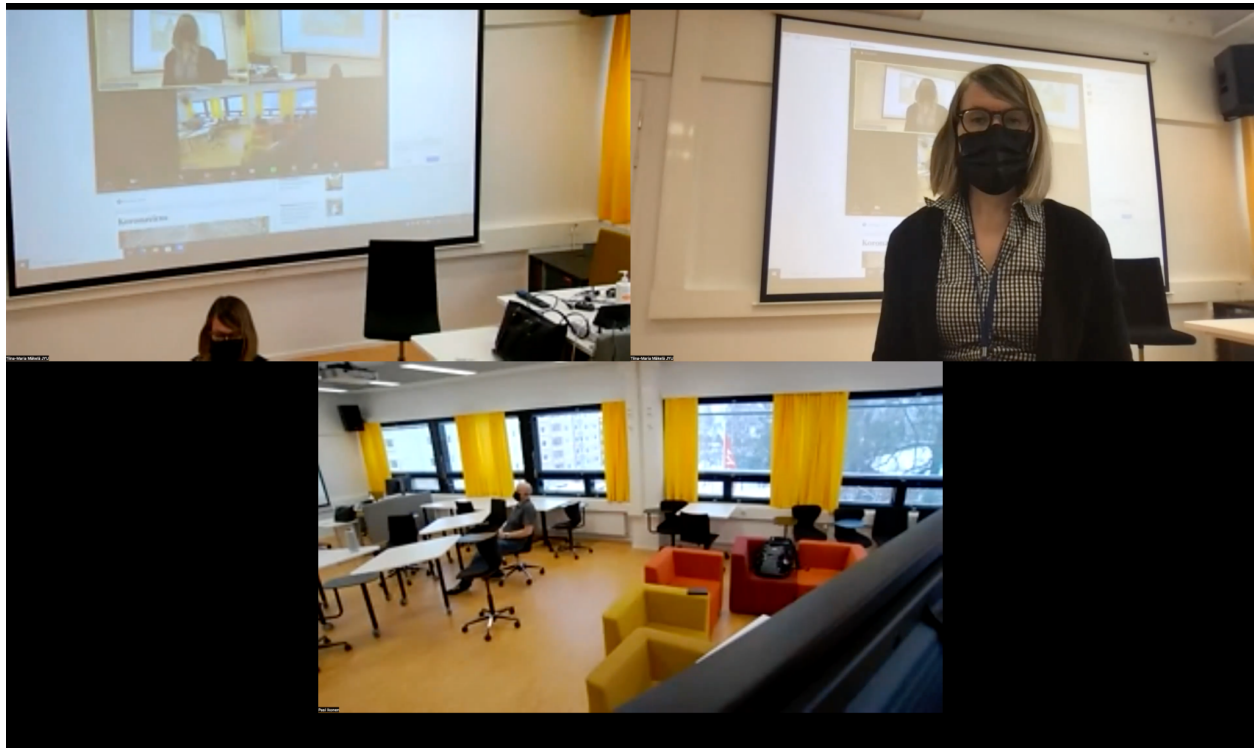

Fig. 2. Videoconference view (screenshot) of the testing of different furniture and technology configurations at the university library's multipurpose space.

Based on the evaluation, the library's multipurpose learning spaces and their technological equipment enabled both frontal teaching and working in different sized groups synchronously with onsite and online participants. It is also possible to record the sessions for asynchronous use. Further, the live video stream makes it possible to have an audience, for instance, in the library café with the wall-sized screen. This was seen to enable informal learning and opening-up sessions for a wider public.

For synchronous hybrid sessions entailing group discussions between onsite and online participants, an interactive whiteboard computer with a video camera can be connected to three ceiling microphones. This way, online participants can hear everyone speaking in the room. It was noticed, however, that there was some delay and difficulty following the conversation online, if onsite participants moved between microphones or if various people talked in the room at the same time. It was also necessary to turn off the audio from devices that were not in use during the discussion. For small group discussions mixing onsite and online participants, using individual laptops was found to be more suitable. With some distance between laptops, interference between them was avoided. Small groups could also spread outside the room to other spaces of the library.

The group testing the space discussed that it could be beneficial to have onsite participants log into videoconferencing systems with cameras from their mobile devices or laptops. This would allow online participants to see onsite participants individually. This would also enable participants to chat and get access to shared links. In addition to video cameras, it was noticed that connecting mobile devices and their cameras to videoconferencing systems would enable moving with the camera around the space. In the case of being connected to a videoconference with various devices and cameras, it was seen as necessary to direct participants' focus, either with the videoconference software or by asking the participants to "pin" one of the cameras to their view.

Based on the three-hour testing, it was concluded that library spaces and multimedia equipment offer possibilities for a wide range of synchronous and asynchronous hybrid teaching from more traditional lecturing to collaborative multidisciplinary and multi-located sessions. Teachers with no previous experience with hybrid environments would, however, need detailed instructions, and plenty of support and training in order to familiarize themselves with all options and to adapt their teaching accordingly. Students also need clear instructions on how to interact efficiently in hybrid environments. It was noted that participants need to adapt to different interaction patterns when involving onsite and online participants. For instance, while it was easy for onsite participants to focus on one of the simultaneous conversations in the room, for online participants, it sounded chaotic. Knowing that sessions are recorded or followed elsewhere was also considered a possible limitation for spontaneous interactions between participants.

3.3   Case B: Expanding Blended-Learning to Synchronous Hybrid Teaching and Learning

In autumn term 2021, the Process Management for Media and Design studio course of the Aalto University School of Arts, Design and Architecture in Finland was organized partly on campus and partly online. The 6 ECT credits course of seven weeks was taken by twenty-four 18–25-year-old students from the BA in Design program. The course was taught by one professor of new media design (author 1), one lecturer in industrial design, and an English language teacher. The language teacher was running a parallel language course, so some of the assignments of the courses were shared. Students received credits and grades from both courses.

The course introduces students to the fundamentals of the innovation process for both products and services. The focus is on the role and value of design within such processes. Students learn to work in a team that is implementing a design process with a customer. Students are also introduced to the basics of social psychology and organizational dynamics, and their practical application in design. The in-class lectures and discussion cover both physical and digital development processes and methods as well as the tools that can be used in them. Through assignments and in-class activities, students learn how to participate in and facilitate creative processes.

In the course, students are divided into six teams, each with four students. The teams are assigned a customer—a non-governmental organization—with whom they practice design consultation and, finally, propose a solution to their customer's design brief or any other challenge they have recognized during the process. Within the course, students study the customers' operations and facilitate design workshops with them. The course ends with presentations to the customers (Fig. 3). The other assignments of the course include note-taking drawing from the lectures and classes, preparing a team presentation (brochure and oral presentation), preparing a facilitation guidebook, and finally, writing a personal study report in the format of a reflective learning journey.

Fig. 3. Student team presented their design proposals for the Finnish Red Cross and the rest of the class on a videoconference.

At the end of the course, students should be able to recognize the difference between process-driven and philosophy-driven development processes for products and services. They should be able to plan and participate in an innovation process and account for group dynamics. They should be able to plan and visually facilitate a creative session for a group of people and utilize facilitation tools and methods in a creative development process.

The course was planned to include 60 hours of classroom teaching and learning. In addition to this, students were expected to spend 60 hours on preparing for the classes and doing their teamwork independently. The students were also given 40 hours to complete their independent writing assignments. The classes included lectures, covering topics of organizational behavior, management, teamwork, design facilitation, agile software development, and offline and online workshop methods and tools.

The course was designed to be a blended learning, so that all the learning materials, including slides from the lectures, are available in the online learning management system, and students are asked to return their assignments to the same platform. Still, it was decided that the most crucial mode of working was the classes in the same time and place with lectures and classroom discussions on homework assignments.

Due to the pandemic, some of the classes were organized so that students who could not attend the class were offered the option of following the lectures and discussions via videoconference. The rule, however, was that students must have a pandemic-related reason, such as quarantine, symptoms, or travel restrictions, for not attending the face-to-face class.

Students were encouraged to organize their first team meetings face-to-face before meeting via videoconferencing. Due to the pandemic, most of the meetings with the customers were conducted via videoconference, although some teams also participated in the organizations' meetings and voluntary work.

To analyze the implications of rapidly moving from blended learning to more hybrid teaching and learning, multifaceted data were collected from the course. The data consisted of recorded videoconference sessions and written feedback from the students.

From most parts, the change to hybrid interaction was deemed successful. Students were already familiar with the main technical tools—videoconference and industry standard online whiteboard software—used in the course. More

challenging than the use of the tools was reaching agreement on the norms and practices. For instance, there were some discussions on what are considered acceptable reasons for students to attend the onsite classroom sessions remotely and how do teams reach an agreement on their collaboration and meetings. Related to remote participation, it was discussed how sick students may attend the class remotely or if they should focus on resting and getting better. For the teamwork, students were asked to prepare a team contract, defining their team members' roles and responsibilities, meeting practices, online tools that are used, and ways to solve possible conflicts in the team. The team contract was found very useful.

The students found the online sessions with customers beneficial because they felt that their future work with customers may also be partially conducted online. However, those students who were able to attend face-to-face events and conduct interviews with the customers also performed somewhat better in the course, which was also reflected in their grades. In this case, those students who, for one reason or another, preferred to work more online most likely did not reach the same level of competency as those who were actively mixing online and face-to-face collaboration.

4   Results: Design Principles for Hybrid Teaching and Learning Environments

Building on earlier research and two case studies, in the following, we present a set of design principles to consider when designing hybrid environments. By design principles, we mean rules of thumb that are delivered inductively from our experience and provide guidance to the design process to increase the chances of reaching a successful solution [25].

First, we define the hybrid teaching and learning environment as the physical and virtual spaces, tools, services, and practices where the participants' activities and interactions can take place both in the same time and place and in a different time and place (Fig. 4). Designing hybrid environments refers to the design of both psychosocial and technology-enhanced physical and virtual environments. The design of the learning environment is such that the different activities in different spaces and times are either programmed by the teacher, or the students are given a choice of where and when to do them, depending on the situation. There seems to be a trend [e.g., 13, 15, 19] that more teaching and learning is going in the direction of extending the freedom of the physical place where learning takes place.
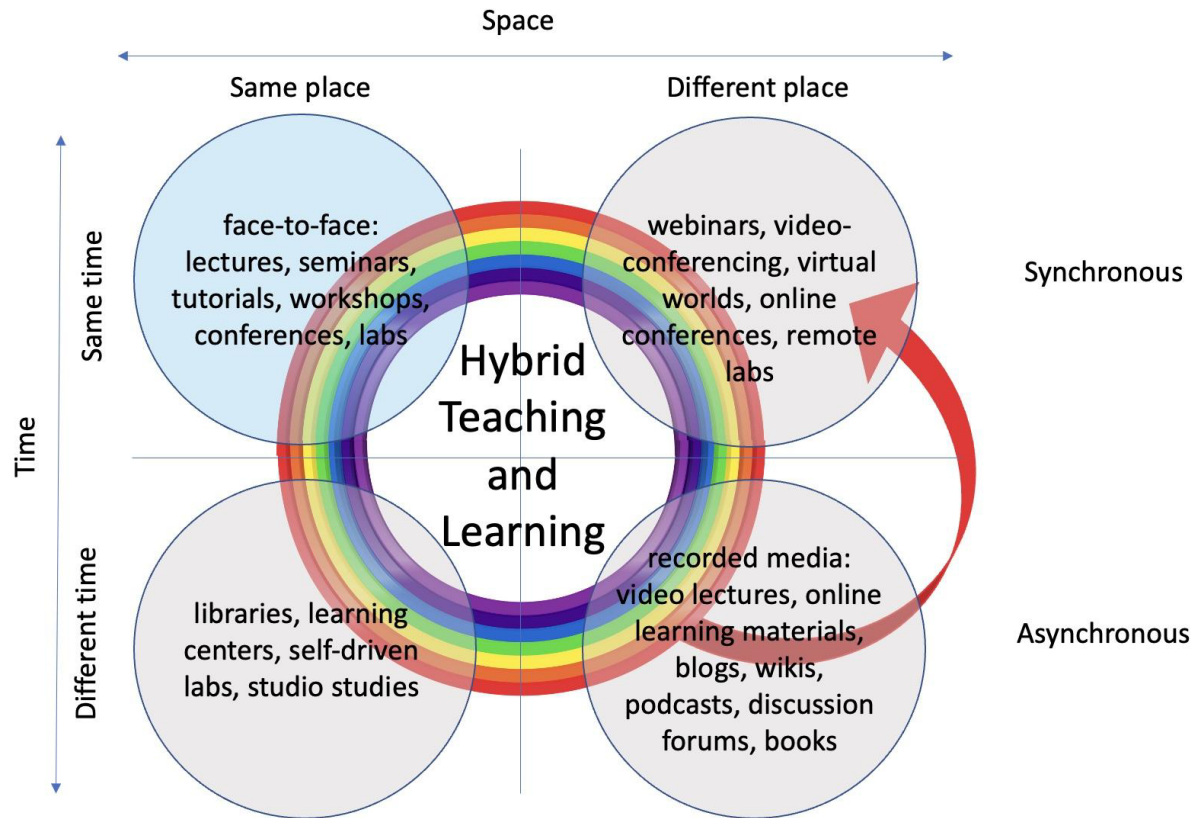
Fig. 4. Hybrid teaching and learning where the same time but different place form is becoming mainstream.

In the following, we present five design principles (DPs) to consider when designing hybrid teaching and learning that aim to overcome the limitations of the same time and space. These DPs are derived from the analysis of two cases aimed at serving hybrid interaction.

4.1   DP1: Ensuring Access to Required Tools, Infrastructure, and Support

To enable hybrid teaching and learning, several technological infrastructure requirements and technological affordances are necessary. In practice, it means that all participants have a broadband internet connection, laptops with front cameras/microphones, and access to online services or software enabling asynchronous and synchronous communication and collaboration. In case B, all students had relatively new laptops and a broadband connection at home and on campus. It was, however, found important to confirm this before the class and be ready to adapt the course arrangements accordingly, if tools or infrastructure were found lacking among the students.

In the case of educational institutions, they have several opportunities to overcome limitations. The institution can provide all students with the necessary tools or provide them as a library service. As found in case A, in synchronous hybrid interaction, it is vital that physical classrooms incorporate a high-quality infrastructure (screens, microphones, stereos/loudspeakers, cameras), enabling bi-directional interactions between onsite and online participants, and supporting teachers' tasks of encouraging student participation and distributing their attention between onsite and online students.

Instructions as well as time for testing and becoming familiar with the tools are needed. In case B, part of the classroom time was used to confirm that all students knew how to use the collaborative online tools. Particularly, hybrid synchronous environments with various cameras, sound systems, and devices require careful planning in advance as

well as a detailed script, which is introduced to all participants in the beginning of the course. In case A, it was also noticed that one should be highly organized in advance; for instance, all technology should be set up and tested [see also 10]. One should also determine how to use audio, visual, and text modalities or how to group onsite and online participants. In case A, the participants pointed out that there should also be some time to test the technology before each session.

4.2   DP2: Design Primarily for Same Time, Different Place Learning (with Recordings)

The current trend seems to be moving more in the direction of the same time but different place mode of teaching and learning. However, the possibility to provide participants with the freedom to choose a different time for learning is also there, as the synchronous sessions can be recorded for later viewing. This was considered an advantage in case A, where the technology in the library enabled various modes of teaching and learning.

There are many advantages to providing opportunities for learning at the same time but in a different place. Firstly, students are free to choose where they attend classes. In case A, the library could work as a meeting point for students who may want to socialize with others, regardless of whether the main focus was on online sessions with those students who prefer to attend the course remotely. Secondly, the latest software for videoconferencing and online collaboration is now widely used in work life. By using these during studies, students will learn important work life skills. In case B, students reported this as one important competency developed during the course. Thirdly, the schedule of the sessions will give students a rhythm to their studies. They can work as checkpoints for teachers to discuss with students their progress with their studies, to give assignments, and to discuss the assignments in a flipped classroom way [26, 27].

Fourthly, as noticed in case A, by recording the synchronous sessions, those students who could not attend the session could watch it afterwards and get some idea about what was happening in the class session. Based on our experiences in both cases, students who participate in synchronous sessions also use video recordings, for instance, to review parts that they found challenging to understand during the session. It is also possible to add subtitles and automatic translations, increase or decrease the speed, and pause the video. This provides possibilities to adapt resources based on one's personal needs. There are, however, some disadvantages related to the recordings. Especially, if the synchronous online classes discuss sensitive topics, participants may not be willing to share their thoughts when the sessions are recorded. This happened in case B, where the teacher did not feel comfortable discussing ethical issues or customers with the group when the session was being recorded. The recording may also cause challenges related to privacy and security.

4.3   DP3: Design Primarily for Same Time, Same Place Learning (with Recordings)

When considering hybrid teaching and learning, it might sound contradictory to organize synchronous online sessions when the participants are in the same physical space. An online session in the same place, however, makes it possible for some participants to attend the session from a distance. This can be done in spaces specifically designed for this, such as in case A. All students may attend the online class from their own laptop at the same time and place on campus, such as small meeting rooms or the campus library/learning center. While the main focus would be on onsite studying, this design would also enable students to participate remotely from their own choice of place. In case A, it was also found that having laptops or mobile phones with cameras helped the remote participants, as they could see close-up faces of all the participants and not just an overview of the classroom.

Using laptops in the same space can be a solution that serves both pedagogy and various students' needs. This model was experimented within case B. It was found especially feasible when working in teams on campus, although all students did not use their own laptops all the time; they also shared one laptop and met with remote participants via videoconference. Additionally, when students presented their progress in the classroom, some teams also had their

remote participants do their part of the presentation over videoconference. In case A, it was also found that enabling all students to chat simultaneously and share links could enhance their interactions.

There are several advantages to this type of hybrid working. When invited to the campus, social events can be arranged between classes, such as having a cup of coffee or lunch with the teachers and the other students. In both cases, having informal discussions on the course content during breaks was considered important for various reasons. During informal discussions, students may clarify many topics discussed during the class. Non-formal get-together events build social cohesion and professional identity and, in many cases, have a positive impact on general wellbeing. In case B, after a long period of remote studies, most of the students highly appreciated the possibility of being in the same classroom. Although it is possible to organize virtual coffee breaks, too, one should not underestimate the power of getting together face-to-face.

As found in case B, another advantage of organizing synchronous online sessions in the same place is that those students who cannot come to campus are still able to more or less equally participate in the class. For instance, one student in case B was in Australia and could not travel to the University because of the travel restrictions. Without the hybrid learning arrangement, he would have missed the first half of the course and would not have been able to complete the course. From the analysis of case B, it can be concluded that if everyone is on their laptop, the situation does not differ too much between the participants. Everyone could have the same tools to participate in class activities, and the teacher is obligated to design the activities so that everyone can participate in them equally. This was also noticed in case A.

A disadvantage of this arrangement is that remote participants are left out of informal discussions. This requires the teacher to brief the remote participants on all essential discussions related to the course that occurred during the breaks. In case B, the teacher found this very difficult. Knowing who has been in which sessions and who needs what kind of information and support became an overwhelming challenge of information management. Likewise, in case A, it was noticed that providing possibilities for synchronous or asynchronous remote participation limits the flexibility of movement and speech onsite when aiming to transmit everyone's image and voice without interference. In both cases, it was also found that choices in the use of cameras and microphones also weakens both onsite and online participants' control over the interactional space [see also 19].

4.4   DP4: Less is More

The complexity of the hybrid environment grows when the number of ways to participate in classes and modes of working increases. When designing the hybrid teaching and learning environment, it is important to think about students' abilities to focus on their studies, rather than overloading them with needing to make decisions on how they can do it. Simple rules, such as in case B where they discussed acceptable reasons for not attending the face-to-face classes, will help students and the teacher. Also in case B, one team assignment was to prepare a team contract, defining how they will organize their hybrid teamwork, who is responsible for what, and how potential conflicts will be resolved. This was found very useful for both the students and the teacher.

In case A, it was noticed that the library and its technology provided so many possibilities to design and implement teaching and learning that choosing the right tools and methods that support the pedagogy became difficult. Therefore, it would be important to have simple default examples and settings for beginners. Teachers should not spend their time configuring the technology for their use, but rather apply it to their pedagogy. However, access to technological tools, such as in case A, may open up teachers to reconsider their pedagogy and build new best practices.

In case B, the assignment for all lectures, online and in class, was to take notes with a pen and paper, photograph them, and then share them with everyone in the class's online environment, which both teachers and students found beneficial. It was found to help students concentrate on the class, which can be difficult when there are many other

applications and services available in the same classroom. For the teachers, the students' notes were useful for following up students' progress and final evaluations.

4.5   DP5: "Le Bon Dieu est dans Le Détail"

What then works in teaching and learning onsite in class and online is often difficult to grasp in all its detail and, more so, to explain profoundly. A various number of factors affect the experience, and many of them are out of the teachers' control. Therefore, not everything can be designed. There are, however, many details to which we may pay attention.

As already mentioned, it is important that all technology to be used works properly, and if there are challenges, students and teachers must get prompt support. In case B, there was a moment when the classroom video projector did not work, and the teachers had to call support for help. In this situation, the best possible solution was to go to the nearby cafeteria to discuss the theme of the day in small teams and return to the classroom when support had solved the issue. Similarly, in case A, the library offers several spaces for meaningful collaboration, if the technology in one of the classrooms does not work as expected. In these situations, personal laptops can be used to connect with the remote participants.

In case B, because everyone agreed to keep their video on during the online classes, it made it easier for the participants to have feelings of belonging and community. It was, however, agreed that it was not obligatory, if someone felt uncomfortable or had concerns related to their privacy. Similarly, it was agreed that the sessions would not be recorded. This made it possible to have discussions also on sensitive topics. This was also discussed in case A.

In case B, there were also some practicalities that were expected to have an impact on the students' wellbeing. For instance, it was agreed that the videoconference room would always open 15 minutes before the actual class session started and reopen after the session for another 15 minutes. The 15-minute periods were used to play music for all and to have informal discussions. These were also opportunities to discuss topics that one did not want to be recorded and posteriorly shared. At these times, students could ask questions in a small group or one to one with the teacher. Both the students and the teachers found these sessions important. In the case of recorded sessions, students could use the informal sessions before or after class and breaks to discuss sensitive topics that would be left out of the recordings.

5.   Discussion and Conclusion

The trend in designing teaching and learning opportunities is to provide more freedom of the physical space where learning takes place. We, however, see that teaching and learning at the same time and in the same physical space will continue playing an important role in the future. However, more opportunities should be provided, at times, to organize teaching completely online and to provide possibilities for synchronous and asynchronous online participation for students with limited access to synchronous onsite sessions. For this purpose, we have presented five DPs derived from two case studies to be considered when designing hybrid teaching and learning environments.

The first design principle (DP1) presented in this paper reminds us that ensuring access to and support for tools and infrastructure is a precondition for designing teaching and learning environments with more flexibility in terms of time and space. As reminded by Bower and colleagues [10], it is important to match technologies to lesson requirements. Additionally, mobile devices can be used to participate in a session, and mobiles with cameras may also facilitate the visual input [10].

Further, our results suggest that it may be recommendable to prioritize either designing synchronous online (DP2) or synchronous onsite (DP3) interactions. In the design of the actual course and class, one should consider, however, that one model does not fit all students. Attention should be given to designing ways to enhance educational access, flexibility, and student autonomy [7, 10, 17]. Therefore, it is important to consider how to design activities that take place at the same time but in different locations but also activities that take place at the same time and the same place.

That is, opportunities for face-to-face interactions may still be provided when using mainly online environments. Likewise, it is possible to provide possibilities for remote participation for some individuals when working mainly onsite. With all these alternatives, we can take advantage of digital tools that can work as platforms for interactions, and we may provide recordings of it for later viewing, thereby providing access to resources when synchronous participation is not possible. Recordings may also be used when creating materials for flipped learning.

Finally, as always in design, less is more (DP4) and God is in the details (DP5). These principles, often discussed in design circles, are unfortunately not well understood or applied when designing teaching and learning environments. Design is always a matter of making choices. Often, fewer choices are better than allowing everything. There is also a need to consider, for instance, ways to ease teachers' cognitive loads in adapting new teaching methods and activities [10, 15] and dividing their attention between online and onsite participants [10, 18, 19].

We see that the possible "new normal" of more remote teaching and learning may challenge the existing forms of institutional learning. There is the possibility of a new kind of interplay between formal and informal learning with new kinds of educational models and practices. For example, videoconferencing enables having external experts in teaching and learning from all around the world [15, 18]. Working in hybrid teaching and learning environments may provide authentic learning opportunities connected to real-world challenges and enable practicing various skills needed in our society, such as flexibility, patience, empathy, creativity, and problem solving. As described by Pichetola [28], hybridity is very much about blurring the boundaries between physical and virtual, private and public, personal and professional in a context of uncertainty, diversity, and freedom. This is something that can be seen as a characteristic of our time and needs to also be considered in education.

At the same time, we understand that introducing new models and practices is challenging, and the consequences are not necessarily only positive. Therefore, there is a need to codesign the future of education where the same space and time do not play such an essential role, while also considering both the teachers' and students' wellbeing and the quality of education. We also see that this may open up new opportunities for regional development.

This research has several limitations. The DPs presented in this study are based on only two case studies conducted in one country. They are, however, in line with the contemporary literature, indicating that they may be generalizable in other contexts. We are currently extending this preliminary and exploratory study to a participatory design of hybrid learning environments with a greater number of participants and stakeholder groups. This will also lead to further development of these preliminary DPs. The principles presented in this paper could, for example, be divided into more specific sub-principles, whereby the course designer could choose those that fit the context she is working for and in best. Also, more concrete examples could be offered for their actual application, followed by an evaluation of their usefulness. We also look forward to mixing qualitative data gathering methods with quantitative methods, for instance, when evaluating the effectiveness of hybrid learning environments for teaching and learning. There is also a need to deepen our understanding of how teachers can orchestrate hybrid sessions without the over-extensive cognitive load identified in previous studies [10, 15, 18, 19].

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