Designing synchronous hybrid learning spaces: Challenges and opportunities

Morten Winther Bülow
Danish School of Education, Aarhus University, mobu@edu.au.dk

Abstract

In synchronous hybrid teaching, students in different locations, some on-site and others online, engage in learning in a shared learning space. This chapter uncovers the challenges and opportunities associated with this specific hybrid learning space design. By reviewing previous studies in the field and introducing an analytical approach based on the design concepts presented by Goodyear and Carvalho in their ACAD framework, the chapter contributes to the formulation of principles for supporting activity-centred learning design principles and guidelines for network learning in a post-pandemic future.

Keywords

Hybrid learning spaces, blended synchronous teaching, post-pandemic teaching

Introduction: Teaching in hybrid learning spaces

The partial lockdowns and strict guidelines for social distancing have made synchronous hybrid teaching a practical necessity at schools, and, consequently, teachers at all educational levels have had to practice, experiment with and strategies for this type of teaching. Notably, these processes have involved most teachers regardless of their prior experience, interest or competence in this type of teaching. Since the challenges caused by Covid-19 are likely to remain on the agenda for years ahead, research knowledge on the challenges and opportunities related synchronous hybrid learning designs is called for.

This chapter is divided into four major sections. First, I motivate the treatment of synchronous hybrid teaching as it was practiced and problematised during the partial lockdowns in 2020-21. To substantiate the claim that the general knowledge of this type of learning spaces requires qualification, I present findings from existing research and compare them with my own analysis of reflections from teachers in Danish upper secondary education on their practices.

In the second major section, the analytical framework that forms the structure of the review presented in the following sections is unfolded. Through an activity-centred approach based on key concepts presented in the ACAD framework (Carvalho & Goodyear, 2014; Carvalho & Yeoman, 2021; Goodyear et al., 2021), I intend to unfold an approach that highlights the coherence between the design dimensions of the learning designs realised in teachers' practices. Choosing this perspective in structuring the literature review makes it possible to change the point of view: "… from the science of learning to the pragmatics of educational design. 'Pragmatics' is concerned with action – with how people make sense of things, and get things done, in real world contexts. ACAD aligns with the need for actionable knowledge." (Goodyear et al., 2021, p. 6)

In the third major section, I review academic writings published in recent years on the subject. The aim is to get an overview of present-day challenges and opportunities associated with this specific type of hybrid teaching – and to clarify what experiences have been gained with various types of planning and

implementation of synchronous hybrid teaching in different educational settings. Based on a thematic review of literature, this section seeks to respond to the need of a more pragmatic insight into what can be learned from the experiences with synchronous teaching in hybrid settings. The review is structured in such a way that it focuses on the three design dimensions in the ACAD framework – the set design, the social design and the epistemic design – as they are presented in the literature.

The fourth major section contains an assessment of trade-offs between potential benefits and challenges associated with synchronous hybrid teaching and learning. The final part of this section discusses how the insights from this study can be used as a starting point in formulating principles for the improvement of upper secondary school teachers' pedagogical design competencies and possible organisational aspects and training processes, supporting activity-centred learning design principles and network learning in a post-pandemic future.
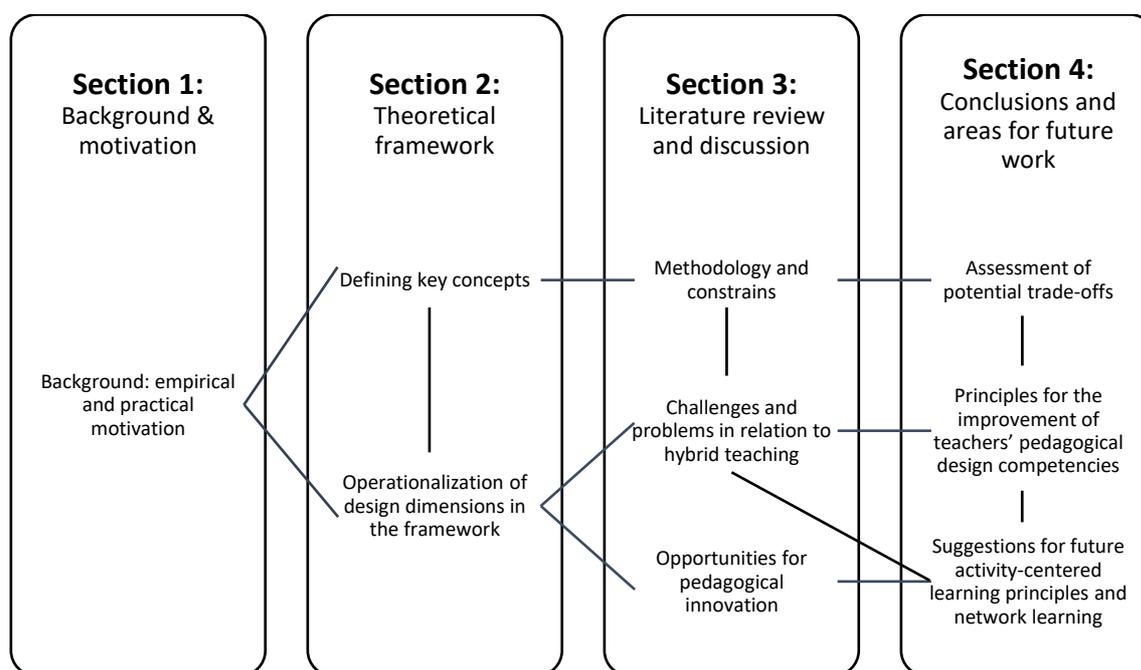

Figure 1 Major sections of the chapter

Background and motivation

In late 2019, Raes et al. published an extensive review of existing research on the knowledge of synchronous hybrid teaching. The review included 47 academic publications published from 2003 to 2017, focusing on the challenges and opportunities identified in teaching designs based on practises where both on-site students and distance students take part in learning activities at the same time, but at different places, sharing the same synchronous learning space. When zooming in on the opportunities identified in their review, I find that the existing research was primarily based on qualitative studies and delimited educational experiments evaluated over short periods of time – often a single course (Raes et al., 2020, pp. 269–290).

Despite these limitations, the organisational advantages of synchronous hybrid teaching were the most obvious, according to Raes et al. For example, the dropout rate was lower, and access to teaching became easier for students living in remote areas (Amarin, 2020, p. 798). In this way, educational institutions could

cope with declining youth cohorts and offer disadvantaged students better opportunities (Ørngreen, 2015; Qiyun Wang et al., 2017). From the perspective of the students, distance learning provided a significant advantage in that they could choose courses and study topics that were not offered at their place of study. They pointed out that the possibilities for inviting experts and guest lecturers are much better in hybrid learning environments – and that this involvement of external resources was a significant contribution to an education with a global perspective (Bell et al., 2014; Munger et al., 2014).

In several publications, the experience of more freedom and better social connections between face-to-face students and distance students, and between the lecturer and the students, were mentioned among the most important findings. According to research, it is also more likely that a synchronous hybrid learning environment enhances the experience of control and the possibilities for planning (Lakhal et al., 2017; Qiyun Wang et al., 2017). Qualities such as career learning and practical experience of working methods and technologies that are common at workplaces in the Fourth Industrial Revolution are mentioned in a few of the sources. Raes et al. find the lack of systematic studies of the differences between the experiences of face-to-face students and distance students regrettable. Nevertheless, they find that the negative consequences of the hybridisation of the learning environment are limited – pedagogical as well as organisational. The students' motivation and their results seem to be higher or at the same level as those found in traditional face-to-face courses. Raes et al. made the following conclusion:

> *"… all studies provided cautious optimism about synchronous hybrid learning, which creates a more-flexible, engaging learning environment compared with fully online or fully on-site instruction."*

(Raes et al., 2020, p. 286)

Quite contrary to the findings above, one of the prominent voices in the Danish debate about the potential expansion of the use of synchronous hybrid teaching concluded: 'Hybrid teaching is impossible'.

> *"(in) hybrid teaching, where teachers teach pupils present in the classroom, and those who participate online from home at the same time. It is not only a huge strain on the teachers, but also an impossible task… as a teacher, it is not possible to prepare for and deliver two simultaneous and meaningful courses with the establishment of close contact with both the pupils sitting at home behind the screen and the pupils who are physically present in the classroom."*

(Kepler, 2020)

These critical conclusions were made by the chairman of the upper secondary school teachers union (GL) – the largest organisation for teachers in Denmark, representing more than 90 % of all upper secondary school teachers. Although this view can be contradicted as Kepler might be confusing parallel and hybrid teaching, thereby missing the differences between these two very distinct modalities of teaching, the critical and rejective conclusion was empirically supported in my analysis of teachers' written reflections collected via the national Danish teacher training programme for upper secondary school education in spring 2020 (in Danish: *Teoretisk Pædagogikum*). This analysis of teachers' reflections is part of a pilot study that I conducted prior to the process of writing this chapter. I did a phenomenological analysis of a randomly selected sample consisting of 42 first-hand, self-reported written reflections from teachers (out of a total of 526 papers submitted in May 2020). These very honest reflections gave me a significant insight into the actions and considerations of teachers during the first lockdown and the subsequent return to synchronous hybrid teaching. It became clear that the hybridisation of the learning spaces influenced the teachers' learning designs in both negative and positive ways. However, most reflection papers portray the teachers' attempts to maintain the status quo. The fact that the teachers sought to maintain their intended learning designs

illustrates a general idea among this cohort of teachers. Even when a large proportion of the students participated online, the tasks and the social organisation were not consciously and systematically adjusted to the new and hybrid learning space.

From the teachers' and the trade union's point of view, it seems that synchronous hybrid teaching is indeed a highly demanding and challenging – if not impossible – way to teach. But according to the students, hybrid learning designs do have the potential to cross-pollinate the more conventional learning spaces. As Angelone et al. concluded in the final part of their paper entitled Optimizing the Technological Design of a Blended Synchronous Learning Environment: "Blended synchronous learning has the potential to increase students' co-presence in support of a seamless learner experience and improve upon the flexibility and accessibility of course offerings if designed well." (Angelone et al., 2020, p. 235).

The issue that we are dealing with in this chapter is therefore whether synchronous hybrid learning spaces offer a relevant and practically applicable way in which educational institutions will be able to design their teaching and learning efforts in the future. The critical backdrop for this chapter's analyses of challenges and opportunities in synchronous hybrid teaching is the currently widespread rejection of hybrid pedagogy and designing for hybrid teaching and learning in formal education in some of the world's richest and digitally connected societies. The intrusive debate amongst teachers and students about the ways in which teachers and schools should choose to define a suitable path that supports post-pandemic learning needs to be informed and challenged.

Theoretical framework

As stated in previous chapters of this book, there are fundamental differences between blended and hybrid synchronous learning – and between parallel and hybrid teaching (Gil et al., 2021; Nørgård & Hilli, 2021)Not only can spaces for hybrid learning be seen as more or less fluid and hard to analyse systematically. The definitions found in the previous chapters also leave room for different interpretations and thereby different approaches to operationalisation in relation to empirical work. While blended learning can be seen as formally organised as sequential activities with shifts between online teaching and on-site teaching (Zydney et al., 2020), hybrid synchronous learning, on the other hand, is defined as more complex learning activities taking place in several spaces synchronously or asynchronously (Butz & Stupnisky, 2016).

By defining the core concept not as hybrid synchronous instruction (Romero-Hall & Rocha Vicentini, 2017) or blended learning but as hybrid learning spaces, I seek to analyse the research literature guided by Goodyear's description of these complex spaces as "spaces in which students' activity is situated and supported by rich mixtures of material and digital tools and resources" (Goodyear, 2020, p. 1045). And he thereby refers to the important role students play "in co-configuring the learning spaces and/or the learning tasks" (ibid), and the ways the students work with their peers in specific social-material contexts (Carvalho & Yeoman, 2021; Goodyear, 2020, p. 1045).

This chapter thereby positions itself along the axis of Physical Learning Space / Virtual Learning Space, On-ground Classrooms / Online Classrooms, Learning in Schools / Learning in the World and Analogue Pedagogy / Digital Pedagogy (Hod & Katz, 2020; Stommel, 2012). By focusing on this multidimensional space for learning, I wish to clarify limitations and possibilities. The given hybrid learning context challenges current (learning) design principles by being synchronous and creating new dilemmas that force the teachers to seek new innovative solutions. In addition, hybrid learning spaces combine:

1.   *physical and digital* places and spaces, offering a specific ecology of resources that can potentially be activated in the learning processes

2.   *formal and informal* social structures, interlinking the triple presence of the classroom, the digital space and the homes of some of the students.

These contexts challenge the teacher's learning design. The teacher must acknowledge – and preferably activate – the students' 'home space' at the same time as the classroom, and the possibilities of the digital room contribute to learning (Goodyear et al., 2021; Green et al., 2020; Kohls, 2019). As Carvalho and Goodyear have emphasised, learning design does not only involve the teacher formulating instructions to students. It also includes considerations regarding how social and physical elements create an overall context influencing the learning activity. These social and physical elements provide new possibilities and impose new limitations on the current teaching.

For the purpose of assessing the design possibilities, the Activity-Centred Analysis and Design (ACAD) framework (Carvalho & Goodyear, 2014; Carvalho & Yeoman, 2021; Goodyear et al., 2021) is used as a frame of reference in the review below. In this context, the design dimensions are applied as analytical concepts which allow us to compare descriptions of learning designs in specific learning settings. In order to understand teachers' work on the designing for learning, we acknowledge that this strategic process involves teachers' exercising the difficult task of predicting intended outcomes by designing emerging learning activities. This design process is based on the teachers' experiences and the contextualised resources at hand. Consequently, learning design must be regarded as developing activities designed for learning – e.g., designing 'learning situations' – but it should not be considered a direct path to specific learning outcomes.

The ACAD framework (Figure 2) illustrates the relations between three structural dimensions. The set design, the epistemic design and the social design are open to alteration through the teachers' and students' co-design – and thereby the dimensions in focus are formed when trying to understand the specific design.
1.   The social design accounts for the division of labour in the formal or informal learning spaces. This can be organisational principles such as group work, roles, peer feedback etc.
2.   The set design or the technological and spatial design: The hybrid character of the learning space is clearly read in the technological and spatial design dimensions. Here, the bodily and digital being is the focus of the analysis, but temporal and chronological (synchronous / asynchronous), chorological (place-bound) and other contextual dimensions are in some cases also included.
3.   The epistemic design describes the activities that the teachers plan and present to the students, such as tasks, challenges, assignments etc. The ways of structuring knowledge and knowing are integral to the epistemic design.
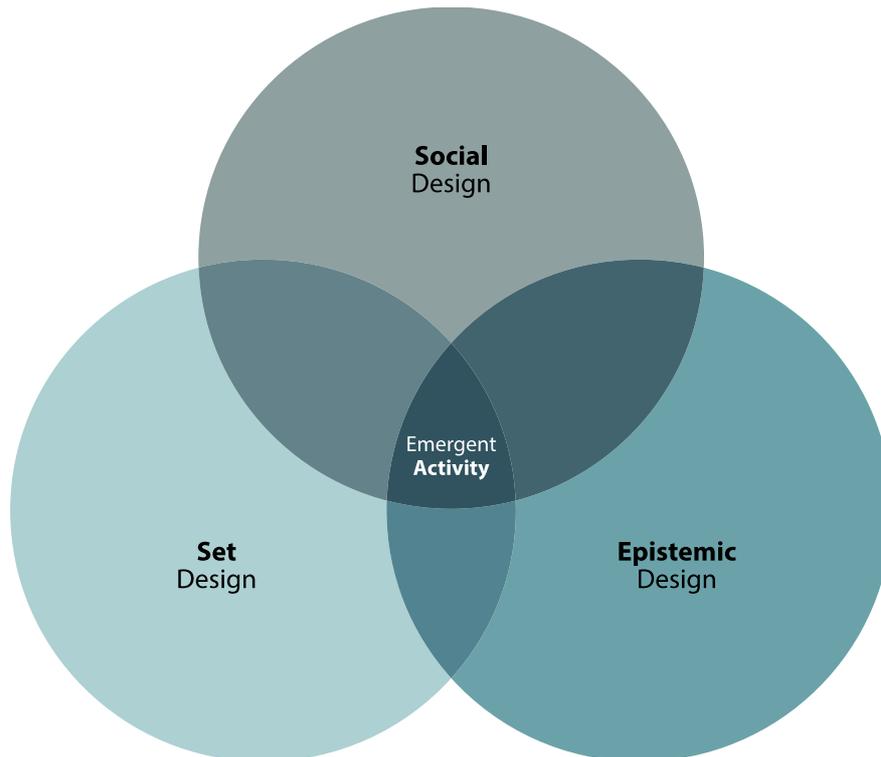
Figure 2 Dimensions of learning designs. Modified version of the ACAD model (Inspired by Carvalho, Goodyear and others)

When we devise epistemic designs for learning, it is essential to recognise that teachers cannot design the learning itself; what students do and what they get out of the activity is not necessarily what we expect or intend. At the centre of the figure the emergent learning activities highlights learner's agency to co-configure what is proposed and the ways in which the designed environment can participate in teaching and learning practice. The student redesigns the planned activities and, in this way, also affects the learning outcome. But educators should be aware that they can design activities based on their expectations – and their understanding of the contextual conditions and resources that the students are offered. In order to explore how past attempts to develop and test specific design interventions that could enhance perceived usefulness of design principles, the objective of this chapter is to come up with an adequate answer to the question: How does synchronous hybrid teaching challenge and support the learning-whole seen as the combination of the set design, the social design and epistemic design dimensions?

Research approaches and methods

In several instances, the applied literature focuses on analysing online teaching and blended learning. But in this chapter, the goal is more narrowly to discover and understand the possibilities and challenges specifically found in hybrid learning spaces that arise when teaching takes place in the classroom and online (for some students) simultaneously.

In the following review, different concepts have been used to guide the search for literature. Aside from "hybrid synchronous teaching", the following search terms have been applied:
1. Hybrid synchronous instruction (Romero-Hall & Rocha Vicentini, 2017)
2. HyFlex course design (Abdelmalak & Parra, 2016, 2016; Binnewies & Wang, 2019)
3. Synchromodal learning (Bell et al., 2014)
4. Synchronous hybrid learning (Butz & Stupnisky, 2016)
5. Synchronous online teaching (Bonk, 2020)

6.   Fusion classroom (Amarin, 2020, p. 797)

These conceptualisations of types of learning spaces all describe situations where learning is situated and integrating the face-to-face and online environments simultaneously. To uncover the relevant literature, I performed a systematic search on the following electronic databases: Web of Science, ERIC and Scopus. The above definitions were initially used as keywords in the searches that were limited to the period 2019-2021. These limitations were made for practical reasons and because of the extraordinary conditions in this period. Aside from that, the review used as the point of departure for this chapter focused on literature from the previous period. For example, whereas Raes et al. looked at the literature published from 2003 to 2017 (Raes et al., 2020) and primarily dealt with limited educational experiments or courses testing synchronous hybrid learning, the partial lockdowns of educational institutions at a global level from early 2020 until now (February 2021) provided quite unique starting points for analyses on a completely different scale.

A search on Google Scholar, for example, yielded no less than 17,000 articles published in the period from 2019 to 2021 containing "synchronous AND hybrid AND learning". The searches in the more specialised databases produced more limited results – especially after a thematic narrowing that excluded all materials that did not meet the criteria "education – educational research", "social sciences", "peer-reviewed only" and "scientific education disciplines". After sorting out duplicates and irrelevant articles (including those that focused only on asynchronous, flipped or blended learning), I analysed 32 articles in full text. To illustrate the methodology, a sample of six analyses is presented in **Table 1.** All these articles have mutual qualities. They contain multifaceted interpenetrations of the hybrid learning spaces, and some of them also emphasise the high degree of agency and freedom as a quality.

Author and year	Title	Method	Designable elements			Findings
			Set Location, spaces and artefacts	**Social** Stakeholders, actors from practices and roles	**Epistemic** Objectives, nature of practices and tasks	
Angelone et al., 2020	Optimizing the Technological Design of a Blended Synchronous Learning Environment	Comparative / case study: qualitative methods to iterative design N=16	Multiscreen projections, swivel camera, classroom speakerphone	Course designated as here or there (HoT) 1. Mixed on-campus and online students 2. Separate online and on-campus students	Each session began with an activity or a lecture. Then the students met in breakout groups to have discussions about the course material, and the class ended with a whole-class debrief.	Blended synchronous learning has the potential to increase students' co-presence in support of a seamless learner experience and improve the flexibility and accessibility of the courses offered.
Little & Jones, 2020	A Comparison of Student Performance in Face-to-Face Classes versus Online Classes versus Hybrid Classes Using Open Educational Resources	Comparative / quantitative survey N = 135	Specific software (My Accounting Lab)	Hybrid: Two sections met twice per week for 50 minutes for the purpose of answering questions about learning resources and assignments.	Multiple-choice exams that included questions that were algorithmic computational type questions. Also, all the questions were sorted.	Students performed better in the hybrid and online classes than in the face-to-face class. Synchronous hybrid learning creates a more flexible, engaging learning environment compared to fully online or fully on-site instruction.
Smith et al., 2020	Are they paying attention, or are they shoe-shopping? Evidence from online learning	Comparative study / mixed methods study N = 30	Zoom (break out rooms)	1. Students and instructor logged on to Zoom 2. Hybrid format courses; some students physically in the classroom and some on Zoom	-	When students and instructor were logged on to Zoom synchronously, the average attentiveness was greater compared to hybrid format courses where some students were physically in the classroom and some on Zoom.
Flynn-Wilson & Reynolds, 2020	Student responses to virtual synchronous, hybrid, and face-to-face teaching/learning.	Comparative study N = 45	Adobe Connect and students located on campus	Students enrolled in virtual, hybrid (combination of face-to-face and virtual) and face-to-face classes over four semesters	Classroom discussions in disability-related courses in early intervention and deaf education.	Robust discussion is not encouraged in the online virtual synchronous courses in education. Results indicated that a learning curve exists in relation to virtual synchronous course delivery.
Magnus et al., 2020	An Educational Laboratory Approach for Hybrid Project-Based Learning of Synchronous Machine Stability and Control: A Case Study	Comparative study: Comparing h-PBL (Hybrid Problem Based Learning) and traditional instruction N = 88	Controllers and machines in electric power systems	Hands-on experience in groups of three to four students	Solve power system problems in real machines and controllers.	The h-PBL laboratory had a positive impact on student learning and grades due to factors that include improving students' critical sense and their problem-solving skills, providing more opportunities for peer-to-peer discussion in group h-PBL activities, and increasing students' interest

					in and motivation to learn through practical engineering applications.
Zydney et al., 2019	Here or There Instruction: Lessons Learned in Implementing Innovative Approaches to Blended Synchronous Learning	Comparative case study: three different cases at two universities that illustrate different implementations of HoT instruction N = ?	Computer / TV monitors, speakerphones, wide-angle webcams, projector screens	In the hybrid approach, groups are heterogeneous (a mix of both "here" and "there" students) and facilitated in the web conferencing space	The hybrid approach incorporates aspects of both Virtual Flipped Classroom and Student-Facilitated approaches.	Sound pedagogical principles along with pragmatic considerations, such as class size, available technology and instructor skills, should guide decisions regarding use of these blended synchronous approaches.

Table 1 Sample studies in hybrid synchronous teaching

How does synchronous hybrid teaching challenge learning?

Synchronous hybrid teaching places great demands on teachers' and students' digital competencies and their digital literacy. The quality of teaching is dependent on whether all participants have the necessary competencies to use the technology effectively. Therefore, the first challenge is to figure out which competencies are present, and how they are supported by the available software and hardware. In Danish upper secondary schools, it is common that students participating in classroom teaching transmit the classroom activities via webcam to students in isolation at home. This is just one of the ways in which students handle the challenges with little or no institutional support or formal demands. Both students and teachers profit from the flexibility and space where they can actively work with the technology and see new possibilities by testing and evaluating the new technological frameworks.

Challenges that primarily arise from	
hybrid set design Location, spaces and artefacts: Tools and resources – the digital and material elements in the learning situation	The technology etc. requires habituation, and complexity must be handled (Flynn-Wilson & Reynolds, 2020)
	Teachers' competencies in navigating the set design are crucial to the learning outcome (Flynn-Wilson & Reynolds, 2020)
	Difficulty communicating to the whole group during the breakout session (Angelone et al., 2020)
	Insufficient technological and pedagogical support or inexperience (Shamir-Inbal & Blau, 2021)
	Students often feel ignored or neglected (Yang et al., 2020)
hybrid social design Stakeholders, actors from practices and roles: scripted roles, division of tasks and social scaffolding etc.	Hybrid learning environments require teachers to coordinate the synchronous use of digital platforms (Ørngreen, 2015)
	Ambiguity about expectations, time pressure and mental exhaustion causing cognitive overload – hyperzoom/hyperfocus/zoom fatigue (Wiederhold, 2020; Zydney et al., 2019b, 2020; Chemi, 2020; Chen et al., 2017; Green et al., 2020; Szeto, 2014; Zydney et al., 2020; Zydney et al., 2019a)
	Experience of isolation and lack of attention from the teacher and the other students (Blad, 2020; Superville, 2020b; Maxwell, 2020; Smith et al., 2020)
	Group size is crucial when designing for learning. Teaching larger groups may require help from trained support staff (Zydney et al., 2019a)
	Interpersonal communication was lacking (Shamir-Inbal & Blau, 2021)
	Teachers' personal and family-related challenges and work-life balance (Shamir-Inbal & Blau, 2021)
	The students become spectators instead of participants and co-designers of the learning space (Qingqi Wang & Rasmussen, 2020)
hybrid epistemic design Objectives, nature of practices and tasks: exercises: structure, sequencing etc.	The teachers have comparatively more demanding tasks of a technical and communicative nature in synchronous hybrid learning spaces (Zydney et al., 2019a)
	Increased complexity and demands for co-presence (Bower et al., 2015)
	Distance students experience a sense of detachment and difficulties establishing learning cooperation across learning spaces (Szeto, 2014; Rambøll, 2020)

Table 2 A summary of challenges arising from synchronous hybrid teaching

Challenges mainly related to set design

Learning activities are physically situated. Students and teachers use the tools and artefacts at hand when designing for learning. Synchronous hybrid teaching always has unique set designs since the learning is physically situated both in a formal school context and in the students' homes. These conditions challenge the uniformity of the learning design and add an unpredictable and very complex dimension to the design of student activities. According to Flynn-Wilson & Reynolds, the technological configuration and limitations in the software used in the 'synchronous course delivery' do not affect the students' participation and their willingness to participate in open discussions.

> " … we thought that the difference between the more robust discussions in our brick-
> and-mortar classrooms and the less engaging discussions in our online virtual
> synchronous classrooms was due to limitations in the software that was being used.
> However, as the software became more sophisticated we did not see a concurrent
> increase in our students' willingness to engage in discussion nor an increase in the
> richness of discussion in our classes."

(Flynn-Wilson & Reynolds, 2020, p. 50)

Quite surprisingly, the students only preferred courses that were hybrid in design if they had tried it before and were comfortable with the set design. One determining factor linking technology and the social design was the teacher's ability to use the technology at hand and facilitate discussions in hybrid classes. The findings suggest that technical issues are closely related to the teachers' experience and thereby determine the students' satisfaction and participation (Flynn-Wilson & Reynolds, 2020, p. 55).

> "Generally, courses that were hybrid in design were the type of delivery students
> preferred – if they had the opportunity – once they were comfortable with taking virtual
> synchronous classes."

(Flynn-Wilson & Reynolds, 2020, p. 54)

Technology that made virtual or hybrid synchronous teaching possible was chosen over asynchronous online course delivery by most of the students. This preference was supported in other studies. Other studies comparing students' level of expressed satisfaction with the synchronous/asynchronous axes of learning design have found the same positive correlation between the level of synchronous teaching and satisfaction among the students. The interaction between students and faculty was more positive in the synchronous mode platform – and the level of satisfaction increased as students took more courses (Flynn-Wilson & Reynolds, 2020, p. 55).

The technological limitations might not affect the student satisfaction in a measurable way, but the lack of relevant affordance is reported to affect the communication negatively in situations where the teacher uses, for example, breakout rooms in a video conference platform and the text messaging system limits the number of characters that can be sent. A student cited this as an obstacle, noting:

> "I had to wait until a person who was there relayed the information to me. The
> instructor also had difficulty monitoring the online chat while teaching and missed some
> messages from students who were having difficulty".

(Angelone et al., 2020, pp. 227–228)

In cases where the teacher focuses either on the students physically present *or* the distance students, students often feel ignored or neglected. Sequencing, speed and repetitive elements work differently in the various modalities. A number of studies have been conducted on students' behaviours in synchronous hybrid

learning spaces, seen specifically from the students' point of view. Yang et al. carried out a large quantitative study where 41,781 Chinese dental students' behaviours were documented during the period February to May 2020. To summarise, the conclusions were:

> "face-to-face classrooms are significantly more conducive to student-teacher and student-student interactions (...) Internet-based discussion is a less effective educational method compared with in-person discussions, which involve more natural ways of communicating".

(Yang et al., 2020, p. 5)

Challenges on the organisational level are often associated with the physical environment, for example the architecture (small and insufficient classrooms), or they can be related to logistics and digital connectivity. Schools that do not give the teachers sufficient technical or pedagogical support are reported to cause a waste of resources and an unwillingness to use online tools. Supervision and encouragement are critical in order to cultivate students' capabilities to navigate hybrid learning spaces (Shamir-Inbal & Blau, 2021, p. 4).

Challenges mainly related to social design

Another challenge is the fact that the synchronous hybrid learning environment requires teachers to coordinate the synchronous use of digital platforms to a far higher degree than in learning spaces with other configurations (Ørngreen, 2015). It can be mentally exhausting for a teacher to facilitate and coordinate at several levels and use different technologies simultaneously. The teacher must be present in the interaction with the students. At the same time, an inner dialogue takes place aiming at continuous corrections and strategic involvement of relevant digital resources.

Teachers' mental strategies can be portrayed using concepts such as hyperzoom or hyperfocus (Zydney et al., 2019b, 2020). Other terms such as zoom fatigue (Wiederhold, 2020) or the even more comprehensive term academic fatigue (Chemi, 2020, p. 6) critically describe the exhaustion teachers may experience after a lesson where they have had to split their attention. As Chemi describes this experience:

> "There I was, with my brutal workload, obliged to deliver creative solutions under time pressure and psychological stress. I did it, but it was not enjoyable. It was not optimal. It was not to be repeated. Student voices were silent and silenced by a fast-paced problem-solving attitude relying on a number of assumptions about the students' pedagogical and relational needs."

(Chemi, 2020, p. 6)

The experience Chemi describes is characterised by the fact that student voices are given less space – less importance – in the learning design when time pressure and the demand of 'being in several places at the same time' exhaust the teacher. Teachers and students experience the hybrid learning spaces differently. Research shows that agreement in the interpretation of the norms and rules of the situation is essential for the learning outcome (Chen et al., 2017; Green et al., 2020; Szeto, 2014; Zydney et al., 2020). The feeling of being socially disconnected and isolated from classmates and the teachers is often described as one of the most critical consequences in classes where only some of the students joined via Zoom. For example, one participant reported that:"professors can forget about the Zoom students if they are not on Zoom themselves" (Smith et al., 2020, p. 205)

The lack of ability among teachers to share their attention equally between the students present 'in the flesh' and the students attending online made Smith et al. suggest that it might be better for all students to attend

online rather than having some online and some in person (Smith et al., 2020, p. 205). But in a comparative study, Zydney et al. have suggested a possible solution to this problem. If the group size is small enough, the hybrid instructional approaches seem to have a much better chance of success. If students work together in groups of eight or below, experienced instructors can facilitate both audiences. The key word here is, of course, experience, which is mentioned in several articles. Much of the debate concerning the possibility of hybrid learning spaces has a misleading point of departure when not taking into consideration the possibilities of including support staff or allocating time to train the teaching staff or letting them rehearse carefully selected pedagogical patterns collectively – in different physical and digital settings (Zydney et al., 2019a, p. 125).

Some students found it demotivating and distracting when the teacher was not physically present. In many cases, taking attendance was automated in anonymous ways, which makes the students spectators instead of participants and co-designers of the learning space. In a study of so-called resilient hybrid learning strategies, Wang and Rasmussen found that "explicit training of teams skills (including virtual collaboration) enhances the student experience and is also supported by wider studies of communication skills". (Qingqi Wang & Rasmussen, 2020, p. 11) Systematic scaffolding and continuous adaptations strengthen hybrid learning designs of this type. As they write conclusively: Context is key – and this 'key' implies negotiation with the students and allocating time for reflection (Qingqi Wang & Rasmussen, 2020, p. 12).

The work-life balance of both students and teachers might also be challenged by the hybridisation of the learning space. Students' and teachers' families obviously affect their ability to participate actively in learning. The biggest challenge might be the lack of boundaries between family time and study time. It can be a challenge when children or parents invade the learning space. For teachers, the time to design for learning is in a hybridised context radically altered.

> *"Accordingly, boundaries between working time, family time, and leisure time are*
> *important elements in an individual's life, which need to be separate. Thus, during*
> *COVID-19 teachers felt torn between their duties at home and their duties as teachers."*

(Shamir-Inbal & Blau, 2021, p. 19)

Challenges mainly related to epistemic design

The epistemic design refers to the various actions that the teacher wants the students to undertake. This design dimension is the most difficult to identify in much of the literature as most of the research in this area focuses on the set design and the social design. The different ways of structuring knowledge and the qualitative measures of knowledge within a specific field are very seldom mentioned or evaluated. Consequently, I use the descriptions of the teachers' and facilitators' tasks as a sort of proxy for the epistemic design dimensions making up the students' learning space. Teachers have many tasks when teaching in hybrid settings – and as the number of students increases, the tasks involved in managing this environment multiply. This type of teaching often needs more work than online or face-to-face classes.

> *"In addition to delivering content and facilitating discussion, they need to monitor*
> *students in multiple locations, using multiple communication modes (e.g., voice, video,*
> *chat, and polling). Facilitating a web conference while leading a face-to-face group is*
> *daunting for many, causing a significant learning curve."*

(Zydney et al., 2019a, p. 129)

Teachers often have a wish to make the students' teaching experience as uniform as possible. However, it may be difficult to design and carry out the intended pedagogical strategies. Technology develops quickly: Conference systems are expanded with new features, for example raising one's hand, and the students themselves can easily get together in breakout rooms without the teacher dedicating one to them. Flexibility is increased. However, at the same time, complexity and demands for co-presence increase as well (Bower et al., 2015).

Based on a qualitative experimental study of 54 hours of teaching a group of engineering students (N=28), where half of the students were taught face-to-face while the other half participated synchronously through an internet-based video conference system, Szeto concludes that the teachers tended to focus on one of the groups and lower the teaching pace. The teachers tried to get the two groups to function synchronously. However, the consequence was that the students physically present were bored and evaluated the teaching less positively.

> *"In fact, the instructor tried hard to synchronously bring his teaching across to the two groups in a virtual learning environment mediated by the video conference. This is the challenge he faced in the blended synchronous situation."*

(Szeto, 2014, p. 4253)

The pattern in the interaction between students developed in an unexpected way in the experiment mentioned. The teacher's intention was that the students should interact synchronously in the virtual environment. However, a spontaneous pattern of interaction arose where the physically present students interacted with each other and demanded a more direct face-to-face supervision from the teacher. The online students had difficulties establishing learning cooperation across learning spaces. According to Szeto, no peer-feedback was established in the experiment. In the teaching situations, interaction was made difficult. Awkward silence and situations in which students talk at the same time and interrupt the conversation were common experiences in synchronous discussions. The possibilities to contribute with simultaneous comments (chatting) and raising one's hand were experienced as insufficient and a source of frustration. Distance students experienced a sense of detachment, which should be addressed. However, at the same time, several students say that they do not have sufficient self-discipline (Rambøll, 2020, p. 11).

The logic of these examples illustrates a widespread duality. While the transfer between different learning rooms challenges the teacher's planning and structure, it also creates a space of possibilities which encourages activation of functional digital learning tools, making learning processes network-based, broad, synchronous and iterative instead of individual and linear. One can look at the quotes as an indication of a widespread reluctance towards a transfer to hybrid learning spaces. The technological context has changed, but the norms and standards for what is considered good learning environments are fundamentally maintained.

Opportunities in synchronous hybrid learning spaces

The potentially positive consequences of increased use of synchronous hybrid learning spaces can be divided into possibilities related to set design, social design and epistemic design and to the evaluation of the students' learning (outcome). In the table below, the opportunities associated with synchronous hybrid learning in existing literature are systematically listed. The perspectives are divided according to the design dimension on which they have a particular influence: Set design (tools and resources), social design (roles and division of tasks) and finally the epistemic design (learning tasks/exercises: structure, sequencing etc.).

Opportunities that primarily arise from	
hybrid set design (tools and resources – the digital and material elements in the learning situation)	Increased personal freedom and space for more students (Nielsen, 2013; Ørngreen et al., 2013; Qiyun Wang et al., 2017; Raes et al., 2020; Flynn-Wilson & Reynolds, 2020)
	Sense of co-presence helps students contribute to the discussion in a way that is most comfortable for them (Angelone et al., 2020, p. 224)
	Pedagogical flexibility, e.g., flipped classroom (Anson, 2015; Bower et al., 2015; Christensen & Hansen, 2020)
	Increased flexibility and greater control of their learning strategies (Binnewies & Wang, 2019)
hybrid social design (scripted roles, division of tasks and social scaffolding etc.)	Partnering on-campus and online students (Angelone et al., 2020)
	Roles within the classroom distributed according to students' interests (Zydney et al., 2020)
	Increased possibility of participating as a distance student in cases of illness or quarantine (Qingqi Wang & Rasmussen, 2020)
	Opportunity to carry through and document face-to-face supervision (Davidsen & Vanderlinde, 2014; Gaudin & Chaliès, 2015)
	Technology levels out asymmetrical relations (Cook et al., 2020; Konnerup et al., 2019)
	A more student-centred learning environment, enabling more student ownership of the learning environment (Zydney et al., 2019a)
hybrid epistemic design (learning tasks/exercises: structure, sequencing etc.)	Teachers design their own learning activities and free themselves from the routine content. More personal bottom-up initiatives (Shamir-Inbal & Blau, 2021)
	Improved intra-school coordination and strengthened digital school culture (Shamir-Inbal & Blau, 2021)
	The possibility of involving external experts and students' own resources ((Raes et al., 2020; Holm Sørensen & Tweddell Levinsen, 2019; Liu et al., 2018; Nielsen, 2013).
	Democratisation, innovative pedagogy and opening of the learning space (Green et al., 2020)
	Increased student motivation to learn when compared to traditional teaching (Magnus et al., 2020)

Table 3 A summary of potential opportunities in synchronous hybrid learning spaces

Possibilities mainly related to set design

If we look at possible organisational advantages, an increased use of hybrid learning will create more space at educational institutions – not just space for more students, but also space as distance between students. The financial advantages are probably great. More students in fewer buildings and thereby minimised cleaning costs, less wear and fewer sick days. Thus, it becomes possible to increase the number of potential students, which has been seen historically in various contexts – especially when great distances have had to be overcome (Nielsen, 2013; Ørngreen et al., 2013; Qiyun Wang et al., 2017). It is difficult to measure environmental gains, but emission from transport to and from educational institutions can be minimised significantly.

Hybrid teaching may give increased freedom to plan one's life. The time previously spent on transport and social school activities may be spent on local activities and studying. In that way, hybrid learning can contribute to an increased presence and sociality. Educational institutions will have better opportunities to

offer elective subjects or specific courses (or more exotic electives?) which are usually only offered at very few schools (Raes et al., 2020, p. 281).

Dialogical teaching and effective feedback take time, and this time becomes available by an increased use of didactical flipped classroom recordings (Anson, 2015; Bower et al., 2015; Christensen & Hansen, 2020). Synchronous hybrid teaching can give the participants a feeling of increased flexibility and greater control of their learning strategies. This is the conclusion reached in studies of so-called HyFlex environments characterised by students choosing themselves how to participate in a lesson, whether it is face-to-face or virtual (synchronous or asynchronous) (Binnewies & Wang, 2019).

Possibilities mainly related to social design

Some of the often-mentioned disadvantages of distance learning are challenges concerning student absence and declining completion rates. Conversely, it can be argued that the increased flexibility makes it possible for students to maintain in contact with their educational institution and fellow students in cases of illness or while waiting for test results. As mentioned above, it is common for students to participate in lessons with the assistance of fellow students. Offering the possibility of participating as a distance student in cases of illness or quarantine accommodates the wish for continuity regarding, for example, long-term project work. At the same time, it is a flexibility which develops study and career competencies in a society with increasingly more flexible workplaces and increased expectations of self-organisation (Qingqi Wang & Rasmussen, 2020).

The positive didactical potentials are also described in studies of more intimate learning spaces where students are supervised face-to-face. Emphasised advantages include a less disturbing environment and the opportunity to carry through and document face-to-face supervision (Davidsen & Vanderlinde, 2014; Gaudin & Chaliès, 2015). As Zydney concludes:

> *"Extra time should be allocated upfront to set norms for both the classroom setting as well as how to use protocols within that setting. The roles within the classroom need to be distributed according to students' interests and experiences to allow participants to be fully engaged. This may also help address the issue of students getting distracted"*

(Zydney et al., 2020, p. 13).

In the way described, technology not only becomes a material element in the actual 'set design'. It also becomes an element in the social design of the learning space by ending or levelling out asymmetrical relations. The situation becomes more democratic when students as well as teachers join forces in the discovery of technologies. Furthermore, as a resource for the establishment of a fruitful epistemic learning design, technological frameworks – as shown in the examples above – provide flexible tools which support teachers' design and turn learning into a mutual endeavour (Cook et al., 2020; Konnerup et al., 2019).

Possibilities mainly related to epistemic design

Didactical and pedagogical advantages of synchronous hybrid learning spaces are closely connected to organisational advantages. The possibilities to include external experts and the opportunity for students to use resources from home in a school-based context in a more flexible way may have great advantages. In general, it is easier to cooperate with external partners and include students' own networks in hybrid learning spaces. As several studies have emphasised, opening learning spaces towards students' lives and including external expertise can strengthen social relations and be motivational for students. As an example, Sørensen, Levinsen and Liu et al. have emphasised the potentials of the hybrid social design in relation to strengthening global and innovative competencies, which not only exceeds geographical distances but also, according to experiences from Global Classroom courses, gives cross-cultural insights and experiences (Holm Sørensen & Tweddell Levinsen, 2019; Liu et al., 2018; Nielsen, 2013).

An example of democratisation and opening of the learning space comes from an experiment involving 300 nursing students and 27 teachers from New Zealand. Researchers designed a so-called transition programme where students participated in activities through voluntary and fun and informal online 'happy hour' sequences, which created a playful way of learning how to act in the new technological context. A significant lesson from the experiment was that it could have considerable advantages to include employees in knowledge sharing and utilise the knowledge and resource ecology that the context offers. Collaborative learning can be supported in the mutual development of didactical patterns and learning designs. Green et al. describe the plans as follows:

> *"…we are bringing together teams of teachers to jointly develop pedagogical strategies that are socially engaging, pleasurable and productive. Whilst a sudden move to a digital teaching experience can be mentally taxing, there is much to be gained from working with others in a team teaching collaborative environment, for both students and teachers."*

(Green et al., 2020, p. 15)

Conclusions and areas for future work

The objective of this chapter was to answer the question: How does synchronous hybrid teaching challenge and support the learning-whole seen as the combination of the set design, the social design and epistemic design dimensions? The review of the literature published on research from 2017 to 2021 confirms most of the conclusions found in the reviews of earlier research on the subject. Hybrid synchronous teaching and learning is both possible and entails several significant benefits in terms of:

1. Set design: The physical and technological set-ups that support hybrid teaching include hardware such as microphones, wide-angle cameras and a reliable internet connection. The flexibility of these hybrid learning spaces supports innovative learning designs, for example a flipped classroom, and potentially gives both teachers and students a higher degree of control of their learning strategies.

2. Social design: Forming collaborative networked learning and the possibility of participating as a distance student in cases of illness or quarantine.

3. Epistemic design: The hybridisation of the learning space seems to support the teachers' innovative and differentiated development of their own learning activities. Epistemic designs are supported by adaptive teachers who free themselves from the standard content. Both collective and individual bottom-up initiatives that open the learning space to external resources and inspiration for more activating tasks are sustained by the formation of teacher-to-teacher support communities are more likely to form. Synchronous hybrid teaching supports a learning-whole with a higher degree of integration among the teachers as well as between the on-site and online students.

The review also shows that these findings are challenged by numerous design qualities that define the conditions and determines the level of success when it comes to the formation of hard learning spaces of this type. When designing for learning, teachers and schools need to be aware of certain design qualities. Most importantly:

1. Set design: When the necessary technological and physical conditions are not optimal, it will most certainly challenge the effectiveness of the teaching. A set design that supports the formation of an operative synchronous hybrid learning space must have the necessary technological affordances and form a learning space that supports the emergent learning activities. Screens and cameras need e.g., to be set up very carefully to support participation by the students from home.

2. Social design: The shared learning space is highly influenced by the quality and social setting in classrooms as well as in private homes. If students are disturbed by family or the lack of access to

> sufficient technology, the benefits will be challenged. The number of students participating in each work group and the distribution of their responsibilities by the students' teachers and mentors have proven to be crucial to and often challenge the social design of the learning space.

3. Epistemic design: Tasks and assignments need to be adjusted, and the teachers have more demanding technical and communicative tasks in synchronous hybrid learning spaces compared to other learning spaces. The distribution of responsibility connected to the tasks needs to be adjusted and thought through according to the relevant set design and social design.

We can conclude that designing for hybrid learning in synchronous learning spaces is possible. But studies show that the outcome is challenged by the qualities of the design of the learning space: the multifaceted interplay of the social, physical and epistemic dimensions. The social design would optimally support the epistemic dimensions by reducing the complexity. All three designable elements or dimensions depend on the allocation of time and knowledge performed by the teaching staff and the students in collaboration. The design process should follow principles where qualities like time, technology, space for collaboration and work-life balance are taken into consideration.
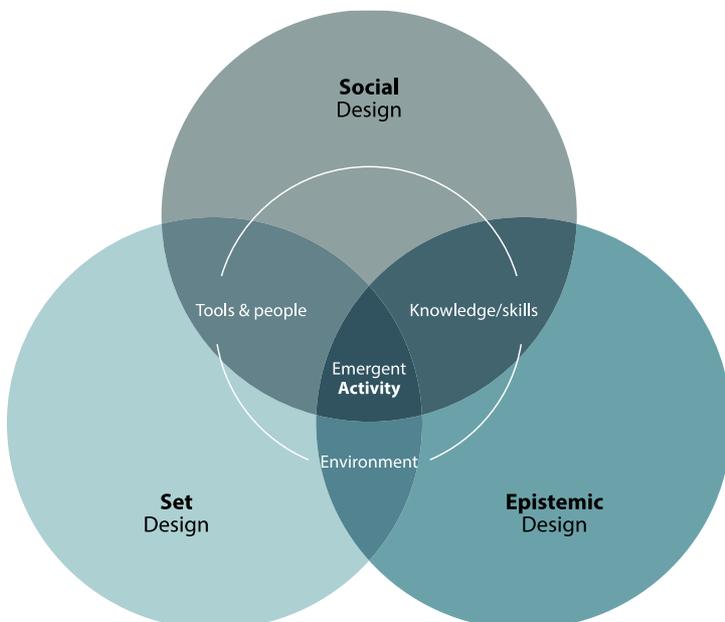

Figure 3 Preliminary draft for a context-sensitive activity-centred design framework (Inspired by (Carvalho & Yeoman, 2021; Cook et al., 2020; Goodyear et al., 2021; Luckin, 2018; Yeoman & Wilson, 2019))

Following the findings above future work should preferably investigate: 1) How the epistemic design dimensions affect the effectiveness and the learning outcomes in different configurations of hybrid learning spaces. In the literature reviewed in this chapter the epistemic design dimensions are mentioned but is seldom given decisive importance. 2) The possibilities of handling the trade-offs and challenge listed above by developing practical methods for involving students' ecologies of resources and thus providing teachers with tools for overcoming the barriers that exist for the successful implementation of synchronous hybrid teaching. A perspective that should be investigated further could be based on Lev Vygotsky, situational theories of learning and the analyses made by educational scientists such as Luckin (Luckin, 2010, 2018), Yeoman and Wilson (Yeoman & Wilson, 2019) and Cook et al. (Cook et al., 2020). Exceeding the barriers for successful innovation and Implementation of synchronous hybrid learning identified in this chapter is likely to require a far greater knowledge of the possibilities of involving learner's agency supported by learning designs that enable teachers to gain insight into the students' zone of possibilities. This vision is illustrated in

Pre-print to appear: Bülow, M. W. (forthcoming). Designing synchronous hybrid learning spaces: Challenges and opportunities. In E. Gil, Y. Mor, Y. Dimitriadis and C. Köppe (Eds). *Hybrid Learning Spaces.* Springer.

Figure 3 above, which shows a preliminary draft for a context-sensitive activity-centred design framework supplemented by dimensions of ecology of resources.

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