IO 2 - Synchronous hybrid learning

A1: Report on the state of art research, innovation and good practices of synchronous hybrid learning and conclusions related to the COVID 19 context

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Introduction

This report is an analysis of the current literature on synchronous hybrid education both in the period before COVID and during the pandemic. Taking into account the needs of teaching staff and support staff in an emergency situation (see IO1) and conditions for change management (see IO6), the report describes the lessons learned regarding the instructional design of synchronous hybrid education based on existing research and educational practices at KU Leuven. KU Leuven is partner of the EU project 'Digitel Pro' in collaboration with DCU, TU Delft, FIED, UOC, Open University and EADTU. This is an analysis (a) completing the literature review from 2018 on and (b) refocusing the conclusions on the COVID 19 needs.

The global pandemic forced us to rethink education to fight Covid-19 and apply social distancing during lectures. Luckily, we could rely on earlier research into distance education in general, and more specifically, into synchronous hybrid learning. During synchronous hybrid learning both on-site and remote students are connected and taught synchronously in what we call at KU Leuven university the “hybrid classroom” or “hybrid lecture hall”. In order to further substantiate this potential new normal, research is needed to investigate the influencing factors of engagement and learning in these new environments from a student and teacher perspective.

In this report we summarize the literature that has been done before and during COVID on synchronous hybrid learning.

Systematic literature review part 1 conducted before COVID 19

The systematic review on synchronous hybrid education before COVID 19 has been published in Learning Environments Research was is part of the Intellectual background that KU Leuven brings into the European Project on Professional Development for Hybrid, Blended and Online teaching during and after the COVID Pandemic.

Reference: Raes, A., Detienne, L., Windey, I., & Depaepe, F. (2020). A systematic literature review on synchronous hybrid learning: gaps identified. *Learning Environment Research 23,* 269–290 https://doi.org/10.1007/s10984-019-09303-z

Context

Within the context of two research projects (TECOL, see https://www.kuleuven-kulak.be/tecol?lang=en and the imec.icon project LECTURE+, see: https://www.imec-int.com/en/what-we-offer/research-portfolio/lecture) new learning environments have been constructed at KU Leuven since 2016 in collaboration with some industry partners. The newly designed learning spaces function as living labs to study new modes of teaching and learning. The two settings are equipped with innovative educational technology and all students have access to the same interactive platform shown in Figure 1 and Figure. 2, allowing them to participate in the course, either on-site or from a remote location.

The picture on the left depicts what we called in 2017 the **“Remote Classroom”**, the picture on the right depicts the **“Hybrid Classroom”**. Both learning settings have in common that both on-site or “here” students and remote or “there” students are simultaneously included. This kind of learning

and instruction is also framed as **"Here or There (HOT) instruction** (Zydney, McKimmy, Lindberg & Schmidt 2019). The differences between the Remote and the Hybrid Virtual Classroom emerge from the location of which students follow the lecture. In the Remote Classroom setting, one group follows the course on campus and another group follows the course synchronously from another campus (the remote location and students are displayed on the screen depicted on the left corner of the picture in Fig. 1) (Szeto and Cheng 2016).

Figure 1

Two models of synchronous hybrid learning at the living lab of the university, Situation in 2018

The Remote Classroom

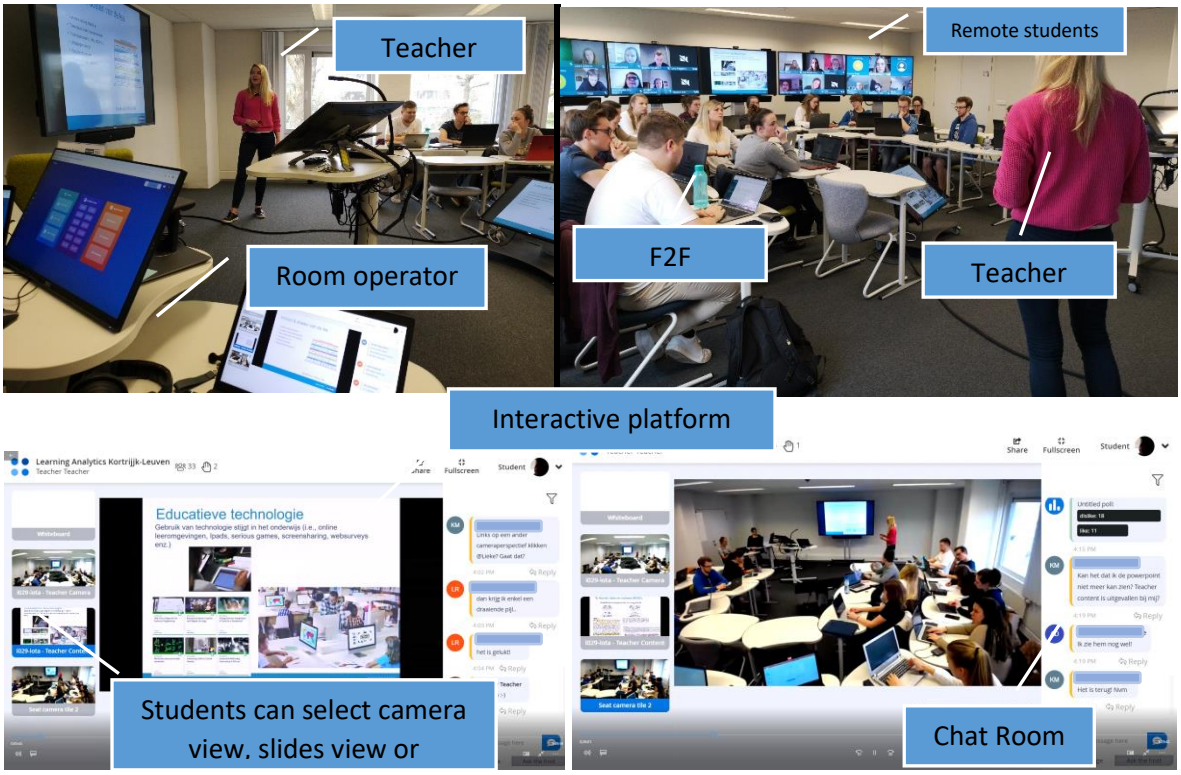
The Hybrid Virtual Classroom

In the Hybrid Classroom, one group follows the course on campus and simultaneously individuals follow the course remotely from the location of their choice (Butz, Stupnisky, Pekrun, Jensen & Harsell 2016; Hastie, Hung, Chen & Kinshuk 2010). This method of teaching offers even more flexibility because it gives adult students, as well as students who are, for example, abroad or ill for a longer period of time, the opportunity to participate in the actual lesson and to interact at a distance with all the students and the teacher from a place of their own choice.

The two settings are equipped with innovative educational technology and all students have access to the same interactive platform WeConnect (https://www.barco.com/en/page/lx/virtual-classroom) shown in Figure 2, allowing them to participate in the course, either on-site or from a remote location. The platform gives access to the sources the teacher is using during his or her lecture (e.g. power point slides or annotations made on the digital whiteboard), facilitates launching quizzes or polls and is equipped with a chat room which gives students the possibility to chat with each other or with the teacher during the lecture. Lectures in the Hybrid (Virtual) Classroom are mostly assisted by a room controller who follows up on the chat, can launch the quiz or poll and can mute or unmute remote students.

Figure 2

Upper pictures display the Hybrid Classroom including both F2F and remote individual students. Lower pictures display the platform visible for the students.



The redesign of our learning spaces was based on current societal transitions and in the context of the EU Lifelong Learning Program. Regarding higher education settings, current policy documents often refer to the possibilities of multi-campus learning and inter-institutional collaboration by connecting remote groups with the traditional face-to-face classrooms (see for example the 'Going Digital strategic plan of KU Leuven: https://www.kuleuven.be/english/about-kuleuven/strategic-plan/going-digital). Furthermore, the need for connecting remote individual students is increasing as the population in higher and adult education is getting more diverse. "Lifelong learners" often cannot attend traditional classroom instruction due to, for example, family or work commitments. Within this context, digital technologies are often put forth as a possible answer to change the educational landscapes and make it more flexible and accessible for a larger group of learners (Cain 2015). As access to synchronous communication tools improves, the lines between traditional face-to-face and online models of education (e.g. MOOCs) have become blurred, making way for **new synchronous hybrid or blended approaches** (Alexander, Lynch, Rabinovich and Knutel 2014; Roseth, Akcaoglu and Zellner 2013). Previous studies show that different models of **synchromodal classes can be designed and implemented** (Bell, Sawaya & Cain 2014; Bower, Dalgarno, Kennedy, Lee & Kenney 2014, 2015).

Research objective & search strategy

At the start of the research project on synchronous hybrid learning (situated in 2017) we aimed to conduct a systematic review before starting new studies as the research field can learn a lot from earlier studies and prevents both the research field and practitioners from making the same mistakes. As stated earlier without a systematic review, a new trial might add little to what is already known in the field (Baumeister and Leary 1997; Bettany-Saltikov 2010a, 2010b).

In this case we aimed to summarize existing evidence concerning synchronous hybrid learning with regard to the benefits, the challenges and the current design guidelines. Based on this state-of-the-art, we further aimed to identify existing gaps in current research in order to suggest areas for further investigation.

Inclusion and exclusion criteria

As the setting under review was relatively new and one of the objectives was to find commonalities and gaps in research, the review considered studies that explored any aspect of synchronous hybrid learning and teaching. We did not predefine the population or the topic of interest the study should focus on. Neither, we predefined criteria related to the method of the study as we were especially interested in the kind of studies that already have been conducted. This means that a variety of quantitative and qualitative study designs were considered for inclusion. Also this review considered studies that explored any learner outcome (i.e. cognitive and affective outcomes) as long it was studied within **the context of a synchronous hybrid or blended learning environment in the form of a remote classroom or a hybrid virtual classroom as described above**. This means that this review did not include literature focusing on the pure virtual classroom only including remote students without on-site students.

Search strategy

A specific search strategy was followed to find both literature published in peer-reviewed journals and grey literature (including for example conference proceedings). This included a search of electronic databases and a manual search of the reference lists of all the identified relevant articles using the snowballing method. We systematically searched the following electronic databases: Web of Science, ERIC, Scopus, and LearnTechLib. Keyword descriptors for publications on synchronous hybrid learning and teaching comprised the following groups of search terms: (a) simultaneous, synchronous; (b) hybrid, hyflex, blended; (c) face-to-face, face to face; (d) education, teaching, learning. Search terms within each group were combined by means of a Boolean OR. The four groups of search terms were combined by means of a Boolean AND. In addition, to exclude studies on asynchronous learning this term was entered by means of Boolean NOT. Dependent on the options of the different databases, the results were further refined by the filters ‘Education - educational research’, ‘Social Sciences’, ‘Peer reviewed only’ and ‘Education scientific disciplines’. This resulted in the following full search query:

TS=(simultaneous OR synchronous) AND TS=(hyflex OR hybrid OR blended) AND TS=(face-to-face OR face to face) AND TS=(education OR teaching OR learning) NOT TS=(asynchronous)

Articles deemed relevant were retrieved for full-text review and were assessed for inclusion using the pre-established selection criteria. Studies were limited to the English language. There were no date limitations placed on the review.

Results

State-of-the-art of research on synchronous hybrid learning (before COVID)

To get insight in the **State-of-the-art of research on synchronous hybrid learning**, each publication was analyzed with regard to (a) the study design and research methodology, (b) the study purpose, (c) the learning setting (Is the synchronous hybrid learning environment shaped as a Remote Classroom connecting groups or as a Hybrid Virtual Classroom connecting on-site participants with remote individuals?), and (d) the context of the study and the number of participants. Table 1 summarizes the results of this analysis.

The first study on synchronous hybrid learning dates from 2003 and was a qualitative case study aiming to observe the quantity and quality of human interaction between the instructor, the on-site students, and the distant students in a blended learning course. Also the work of Beatty (2007, 2010) was pioneering in the development, and evaluation of the HyFlex course design model for blended learning environments. This work is also used in the course on conceptual challenges. Yet, the most studies date from a later period, i.e. published between 2013 and 2019. Most of the studies are case studies (28 in total), 15 of them using mixed methods, 13 of them only using qualitative analysis. Next, one review study and two conceptual studies were identified. Empirical studies are limited. Only five studies were found taken a comparative approach to study the effectiveness between different modes of delivery. Only one experimental study was found. This study was set up from a pretest-posttest experimental design with random assignment using a convergent parallel mixed methods approach (Butz & Stupnisky 2017). With regard to the learning setting, it was found that the majority of the studies (29) investigated the hybrid virtual classroom. Only five studies reported exclusively on the remote classroom, while three studies tackle both the remote and the hybrid virtual classroom in their publication. Lastly, regarding the context of the study almost all studies are conducted in the context of higher or adult education settings. Only one study focused on the pedagogical utilization of remote classrooms in contemporary elementary schools (i.e. Anastasiades et al. 2010).

Table 1

Alphabetical overview of the included studies based on the systematic search (part 1)

Authors + year	**Learning setting, context & participants**	**Study design & methods**	**Study Purpose**
Abdelmalak and Parra (2016)	Hybrid virtual classroom N = 6 graduate students	Qualitative case study	Exploration of students' perspectives regarding the HyFlex course design.

Alexander, Lynch, Rabinovich and Knutel (2014)	Hybrid virtual classroom N = 171 university students	Mixed methods case study	Providing a snapshot of the hybrid learning environment at Bentley University that can be used as a model by those in the planning stages or early formation stages of a hybrid online course or program, and evaluation of students' experiences.
Anastasiades, Filippousis, Karvunis, Siakas, Tomazinakis, Giza, and Mastoraki (2010)	Remote classroom Context: K12 education – grade 6 N = 45 students and 4 teachers from 2 schools	Mixed methods case study	Presentation of the design, implementation and evaluation of the methodology which focuses on the pedagogical utilization of Interactive Videoconferencing (IVC) in contemporary elementary schools.
Beatty (2007, 2010)	Hybrid virtual classroom Context: Adult and higher education N = 34 students	Mixed methods case study	Description of the HyFlex course and evaluation of students' participation and satisfaction.
Bell, Sawaya and Cain (2014)	Remote classroom & hybrid virtual classroom Context: Hybrid PhD program N not specified	Mixed method case study	Description of different models of synchromodal classes designed and implemented.
Bower, Dalgarno, Kennedy, Lee, and Kenney (2014, 2015) and Bower, Lee and Dalgarno (2017)	Remote classroom & hybrid virtual classroom Context: higher education including 7 design cases	A cross-case qualitative analysis study	To examine how design and implementation factors influence student learning activity and perceived learning outcomes and describe this in a Blended Synchronous Learning Design Framework.

Brumfield, Carleo, Kenny, Melendez, O'Neill, Polanin, and Reynolds-Allie (2017)	Remote classroom Context: adult education	Qualitative case study	Description of the concept and the design of the course.
Butz and Askim-Lovseth (2015)	Hybrid virtual classroom Context: higher education N = 202 graduate students, 120 on-campus and 82 online	Exploratory quantitative study comparing different student groups: online vs. on-campus, and domestic vs. international	Examination of the relationships among attendance mode, student nationality and oral communication assessment scores in a synchronous hybrid program.
Butz and Stupnisky (2016, 2017)	Hybrid virtual classroom Context: higher education N = 83 graduate students, 26 on-campus and 57 online	Pretest-posttest experimental design with random assignment to either the experimental group or the control group, using a convergent parallel mixed methods approach.	Implementation and evaluation of an online discussion board intervention designed to scaffold feelings of relatedness and self-efficacy in synchronous hybrid learning.
Butz, Stupnisky, Pekrun, Jensen, and Harsell, (2016)	Hybrid virtual classroom Context: higher education N Time1 = 118 students, 48 on-campus and 70 online N Time2 = 100 students, 37 on-	Exploratory quantitative study comparing online vs. on-campus students using longitudinal analyses.	To investigate students' self-reported enjoyment, anxiety, and boredom as predictors of their program achievement and successful technology use.

	campus and 63 online		
Cain (2015)	Hybrid virtual classroom Context: higher education N not specified	Qualitative case study	Description of how instructors and support staff involved in the hybrid program and explanation of their innovative solution, i.e. the role of an in-class technology navigator.
Cain, Bell and Cheng (2016)	Hybrid virtual classroom Context: PhD program N = 12 doctoral students (11 remote, 1 on-site), 1 instructor, 1 teaching assistant (TA), and 1 TechNavigator.	Qualitative case study with focus on the design and use of the specific application	Evaluation of the robotic telepresence devices to bring greater individualization to online students in one particular synchronous hybrid course.
Cunningham (2014)	Hybrid virtual classroom Context: postgraduate education N = 4 students followed during real-time online participation	Qualitative case study	Evaluation of the experiences of both online and campus students in light of social presence and activity theory.
Grant and Cheon (2007)	Hybrid virtual classroom Context: higher education N = 18, one group used	Mixed method effectiveness study comparing video and audio conferencing in hybrid classes.	Research on how synchronous conferencing technology affects teaching and learning. Also the exploration of factors bearing on the success and failure of synchronous conferencing in hybrid classes.

	video conferencing exclusively (n = 11), and the other group used only audio conferencing (n = 8).		
Hastie, Hung, Chen and Kinshuk (2010)	Hybrid virtual classroom Context: international collaboration between two educators involving two institutions from two countries in the Asia-Pacific region	Description of nine design modes and empirical case study Data collected over 5-year period	Description of nine modes of synchronous hybrid learning and investigation of the educational and social gains.
Huang, Shu, Zhao and Huang (2017)	Hybrid virtual classroom Context: five teachers and students from two senior schools in china (N not specified)	Mixed methods case study	Study on (1) how the teachers' activities impact teaching effect in their courses? (2) What do high school students expect of their video-enhanced teachers? (3) What actions do remote students take to achieve good learning experience?
Lakhal, Bateman and Bédard (2017)	Hybrid virtual classroom Context: Higher education	Review study	Description of the advantages, challenges, conditions of success and the formulation of a blended session protocol.
Lightner and Lightner-Laws (2016)	Remote classroom Context: higher education Analysis of data collected from all courses offered from fall	Empirical study comparing course delivery modes: online, remote and traditional and its impact on students grades	Investigating the impact of the environment on student performance.

	2009 to fall 2011.	In the timeframe of 3 years, there were 112,973 grades issued across 6316 courses.	
Liu, Spector, and Ikle (2018)	Hybrid virtual classroom Context: four universities were included taking turns in designing, developing and delivering courses in Computational Science and Engineering.	Case study from a developmental approach	Sharing the finding of the project focusing on computer technologies served as the enabler for course development, student projects for model-based learning, and course delivery across different locations.
McGovern and Barnes (2009)	Hybrid virtual classroom Context: postgraduate degree program in advanced clinical pediatrics N = 16 students	Mixed methods case study	Examination of why students choose to participate virtually and the impact of the virtual classroom on learning and communication.
Nortvig (2013)	Hybrid virtual classroom Context: professional Bachelor program in physiotherapy in Denmark	Conceptual study focusing on technological design	Investigation and description of how technology can affect teaching in the synchronous hybrid classroom. Explaining the concept of embodiment of technology, technological transformation and the influence of technology.
Olt (2018)	Hybrid virtual classroom	Qualitative case study using	To investigate the phenomenon of using synchronous online classes blended with a face-to-face classroom from the

	N = 9 remote students	phenomenological methodology	perspective of the remote participant. The study is situated within the initiative “Bridge to Campus” providing the entire freshman year of college through synchronous online coursework.
Ørngreen, Levinsen, Jelsbak, Moller and Bendsen (2015)	Hybrid virtual classroom Context: The Bachelor Program in Biomedical Laboratory Analysis in Aarhus	Qualitative case study as a participatory action research project	To identify potentials and barriers from an ICT-supported learning perspective; to develop robust educational designs and teaching scenarios, and to qualify teaching staff in teaching activities which involves the use of the blended class model.
Ramsey, Evans and Levy (2016)	Hybrid virtual classroom Context: Public university N = 19	Mixed methods case study	To present preliminary reflections on their initial experiences and present their survey data regarding students’ experiences.
Rasmussen (2003)	Hybrid virtual classroom N = 6 remote students living in various parts of the western United States + 11 face-to-face students on campus	Qualitative case study	To observe the quantity and quality of human interaction between the instructor, the face-to-face students, and the distant students in a blended learning course.
Romero-Hall and Vicentini (2017)	Hybrid virtual classroom	Qualitative case study	To help inform the design of hybrid synchronous instruction and to understand the effectiveness and efficiency of

	Context: graduate level N = 3 graduate students		hybrid synchronous instruction from the perspective of the distance learners.
Roseth, Akcaoglu and Zellner (2013)	Hybrid virtual classroom Context: Hybrid Doctoral Seminar	Conceptual study	Description of the rationale behind pedagogical choices and specification of various technologies to create a virtual classroom.
Shen, Wang, and Pan (2008)	Remote classroom N = 1000 students, 250 on campus and 750 online	Mixed methods case study	Technical description of the self-developed interactive learning system and evaluation of students' experiences.
Stewart, Harlow and DeBacco (2011)	Hybrid virtual classroom N = 46 graduate students were enrolled in different courses held over the two year project	Mixed methods ethnographic study	Studying the experiences of learners participating in multi-site education classes.
Szeto and Cheng (2016) and Szeto (2014, 2015)	Remote classroom Context: computer-aided engineering drawing course N = 28 students, 14 face-to-face,	Qualitative case study	Studying the impact of the environment on students' social presence experience.

	14 as remote group		
Vu and Fadde (2013)	Hybrid virtual classroom Context: Two sections of a graduate level Multimedia Design course were analyzed: semester 1: N = 15semester 2: N = 13	Mixed methods case study	Exploration of 1) students' choices of verbal and text interaction and 2) students' preference for online or remote participation when given the choice.
Wang, Quek and Hu (2017); Wang, Huang and Quek (2018); Wang and Huang (2018)	Hybrid virtual classroom N = 24 graduate students (in-service school teachers) during 13 sessions of 3 hours	Design-based research (preliminary research, prototyping and assessment)	Description of benefits, challenges & providing pedagogical, social and technical design principles of a blended synchronous learning environment.
Weitze (2015); Weitze, Ørngreen and Levinsen (2013)	Hybrid virtual classroom Context: adult learning 2 classes included N =10 + N = 26	Mixed methods case study with focus on design perspective	Description of students' experiences, the organizational implementation and the development of instructional design, the IT-Pedagogical Think Tank for Teacher Teams.
White, Ramirez, Smith and Plonowski (2010)	Hybrid virtual classroom Context: higher education N = 10 participants	Mixed methods case study	Determination of the feasibility of delivering a course on-campus and in real time, simultaneously transmitting it to students who were remotely accessing the same course.
Wiles and Ball (2013)	Hybrid virtual classroom	Longitudinal mixed methods case study	Description of the design of the converged classroom and

	Context: Undergraduate students, 3707 enrollments over 7 semesters		presenting the benefits and challenges.
Yen and Abdous (2012)	Combination of Hybrid virtual and remote classroom N = 496 university students	Empirical study	Exploration of the relationships between self-perceived learner-to-teacher interaction and learning outcomes and satisfaction across various learning delivery modes (F2F, Satellite broadcast or live video-streaming).
Zydney, McKimmy, Lindberg and Schmidt (2019); McKimmy and Schmidt (2014, 2015)	Hybrid virtual classroom Context: three different cases at two universities	Multiple case study focusing on design and technical issues	Illustration of different implementations of “Here or There instruction”, explanation of the affordances of these varied approaches, and provision of the best practices.

Conclusion and implications for future research, policy and practice (before covid)

Given synchronous hybrid learning was relatively new in 2018, this study aimed to synthesize the best available evidence worldwide to have an overview of the state-of-the-art of the current research during that period. This systematic review brought together the authors experiencing and investigating the benefits, challenges and design guidelines regarding technological and pedagogical support for synchronous hybrid learning. We can conclude that existing research clearly shows the potential of this emerging practice. Despite the challenges, all studies express cautious optimism about synchronous hybrid learning which creates a more flexible, engaging learning environment compared to fully online or fully on-site instruction. Based on the first review, we could conclude that most of the existing literature was still exploratory and qualitative in nature and had focused mostly on the description of students' experiences, the organizational implementation and the technological design.

In line with several researchers (Abdelmalak & Parra 2016; Bower et al. 2015; Butz & Askim-Lovseth 2015; Butz & Stupnisky 2017; Olt 2018; Zydney et al. 2019), this systematic review (Raes et al., 2020) concluded that the research into **synchronous hybrid learning** is still in its infancy. It can be stated that, as with any complex learning setting, initial development and research leads to many more questions. As an emerging practice, synchronous hybrid education especially needs increased empirical investigation to complement the qualitative case studies. Empirical studies have only begun to emerge and more research is needed examining different pedagogical scenarios and its impact on student outcomes. More specifically, the following directions for future were defined based on the results of this study:

1. Future research should include larger and more diverse samples to improve generalizability, but also to provide additional statistical power to identify meaningful effects.
2. Future research should include more empirical and longitudinal data of the participants to investigate the impact of group membership over time. With multiple data points, future research could also endeavor to longitudinally predict students' assessment results based on learning activities.
3. Future research should include empirical real-time data of the learner experience as engagement, social presence or social belonging are multidimensional concepts difficult to measure. Next to self-report data, multimodal learning analytics could be used to better capture and compare students' experiences in different learning settings.
4. Future research should include the effect on student learning and student outcomes across settings and specifically investigate the effectiveness of certain pedagogical scenarios (e.g. quizzes and polls, breakout sessions) for maximizing the learning experience and social presence of remote participants.
5. Future research should investigate the most scalable approach with regard to technical and pedagogical capacity and limitations.

We hope that future research can help in achieving the goal to build evidence-based collaborative technologies that will become so invisible that students and teachers interacting from different locations will feel as though they are in the same room (Bower et al. 2015). Yet, Liu et al. (2018) stress that we still have a long way to reach to these desired states.

Next to theoretical implications, this review study hoped to support policy and practice.

The full report of the systematic review is published in *Learning Environments Research* and can be found online: https://link.springer.com/article/10.1007/s10984-019-09303-z.

Literature review part 2 conducted during COVID 19 (2021-2022)

Context

The global pandemic forced us to rethink education to apply social distancing during the global pandemic. Luckily, we could rely on earlier research into distance education in general, and more specifically, into synchronous hybrid learning (see systematic review part 1).

As synchronous hybrid learning got much more attention since Covid-19, there was a need for additional literature research to complement the earlier systematic review which was conducted in 2019. However, this is an ongoing process and the presented results below can only serve as an interim state of the art and additional insights regarding the conceptualization and implementation of synchronous hybrid teaching and learning, which is the focus of IO2. The plan is to finish (and submit) a systematic review in May 2023. Good practices and resources from other institutions are structured within the IO2-A2 document.

Creating Conceptual Clarity as fundamental step for further literature review

Although KU Leuven decided to conceptualise the concept of merging on-site and remote students at the same time as synchronous hybrid teaching and learning (this concept is also used in the DigiTel pro project), many more concepts are be found in the literature to describe the phenomenon of merging modes. Irvine (2020) emphasised the importance of focusing on the meaning of concepts in order to create a shared understanding for the future of our academic discourse. She provided an overview of the main terms, including **hyflex, multi-access, (synchronous) blended and (synchronous) hybrid**. The **HyFlex (hybrid-flexible)** model was developed by Beatty (2007; 2010) and is described as a combination of hybrid, i.e. combining both online and face-to-face modalities, and flexible, as students may choose whether or not to attend face-to-face sessions. With support from the Canada Foundation for Innovation, Irvine introduced the **Multi-Access** learning model at the 2009 AACE EdMedia Conference and then expanded on this idea in a 2013 article (Irvine et al. 2013; Irvine 2020). The model identifies four levels of access: (1) face-to-face, (2) synchronous online, (3) asynchronous online, and (4) open access. **Hybrid and blended** both refer to combining modes (Lakhal et al. 2017), but the term **synchronously** has later been added (see e.g. Shi et al. 2021; Zydney et al. 2020) as without this specification blended or hybrid are also used to describe learning scenarios operationalising online and offline as dichotomies in which learning takes place either online or offline. Ladd (2020) (Dean of the San Francisco campus) for example mentioned in his article that he is reserving the term “hybrid” for educational experiences where the students in a class group are either all online or all face-to-face in a classroom together. To describe a classroom which has both people online and in-person at the same

time, Ladd (2020) put forth the term **"concurrent classroom".** Other less common terms are **synchromodal** (Bell et al. 2014) and **dual-mode teaching**, meaning that both online and classroom-based instruction is provided in a course at the same time. The term dual-mode is used within CETL (Centre for the Enhancement of Teaching and Learning) at the University of Hong Kong. Recently, Nørgård (2021) also introduced the concept of **hybridity**, meaning that both physical and digital forms take place synchronously, for example through learning interactions that unfold as a coherent experience of being in multiple places at once.

As creating conceptual clarity is very important to find a common ground, the IO2 course will devote the first module of the DigiTel Pro course on the conceptual challenge.

Methodology during ongoing literature review

In July 2021, the first phase of the literature review during covid was conducte. The same strategy was used as in the first review study (Raes et al., 2020).

Search query:

> *TS=(simultaneous OR synchronous) AND TS=(hyflex OR hybrid OR blended) AND TS=(face-to-face OR face to face) AND TS=(education OR teaching OR learning) NOT TS=(asynchronous)*

However, as we found out that we missed some concepts in the field during the first review the following terms were added:

> multi-access, concurrent, dual mode, hyflex and blended synchronous.

Interim results (2021)

Table 2

Alphabetical overview of the included studies based on the systematic search (part 2 – during Covid)

Authors	Title	Year
Angelone, L., Warner, Z., & Zydney, M.	Optimizing the Technological Design of a Blended Synchronous Learning Environment	2020
Bülow, M. W.	Designing synchronous hybrid learning spaces: Challenges and opportunities.	2022
Girons, A., & Swinehart, N.	Teaching Languages in Blended Synchronous Learning: A Practical Guide	2020
Hapke, H. Lee-Post, A., & Dean, T.	3-in-1 Hybrid Learning Environment	2020
Heilporn, G., & Lakhal, S.	Converting a graduate-level course into a HyFlex modality: What are effective engagement strategies	2021

Heilporn, G., Lakhal, S., & Bélisle, M.	An examination of teachers' strategies to foster student engagement in learning in higher education	2021
Kruüger, J. M., Vogel, F., & Schnauber, L.	Synchronous Online Lectures in Emergency Remote Teaching: The Role of Immersion, Social Scripts and Group awareness	2020
Laforune, A., & Lakhal, S.	Differences in Students' Perceptions of the Community of Inquiry in a Blended Synchronous Delivery Mode	2019
Lakhal, S., Mukamurera, J., Bédard, M., Heilporn, G., & Chauret, M.	Features fostering academic and social integration in blended syncrhonous courses in graduate programs	2020
Lakhal, S., Mukamurera, J., Bédard, M., Heilporn, G., & Chauret, M.	Student and instructors perspective on blended synchronous learning in a canadian graduate program	2021
Li, X., Yang, Y., Chu, S. K. W., Zainuddin, Z., & Zhang, Y.	Applying blended synchronous teaching and learning for flexible learning in higher education: an action research study at a univeristy in Hong Kong	2020
Lohmann, M. J., Randolph K. M. Oh, J. H.	Classroom Management Strategies for Hyflex Instruction: Setting Students Up for Succes in the Hybrid Environment	2021
Malczyk, B. R.	Introducing Social Work to HyFlex Blended Learning: A Student-Centered Approach	2019
Miller, A. N., Sellnow, D. D., & Strawer, M. G.	Pandemic pedagogy challenges and opportunities: instruction communication in remote HyFlex, and BlendFlex courses	2020
Naffi, N.	The hyper-Flexible Course Design Model (HyFlex): A Pedagogical Strategy for Uncertain Times	2020
Pierce, R.	Weblive - A Prospective Model for Instruction Post COVID-19	
Raes, A., Vanneste P., Pieters, M., Windey, I., Van Den Noortgate, W., & Depaepe F.	Learning and instruction in the hybrid virutal classroom: an Investigation of students' engagement and the effect of quizzes	2019
Raes, A.	Exploring Student and Teacher Experiences in Hybrid Learning Environments: Does Presence Matter?	2022

Samson, P.J.	Student behaviors in a blended synchronous course	2020
Santos, I. M., Fidalgo, P., Dickson, M., Mohammed, S., Al Jaberi, M.	Using a Video Conferencing System to Expand Student Reach	2019
Shi, Y., Tong, M., & Long, T.	Investigating relationships among blended synchronous learning environments, students' motivation, and cognitive engagement: a mixed methods study	2021
Tian, J., Wang, J., & Wang, X.	Innovating Blended Synchronous Learning Environment to Improve Quality of Education in Small School in Rural Area	2019
Vale, J., Oliver, M., & Clemmer, R. M. C.	The Influence of Attendance, Communication, and Distractions on the Student Learning Experience using Blended Synchronous Learning	2020
Zydney, J. M., Warner, Z., Angelone, L.	Learning through experience: Using design based research to redesign protocols for blended synchronous learning environments	2020

As stated earlier, this review study is ongoing and we plan to finish the review by the end of the DigiTel Pro project.

Recent review study by Bülow on Designing Synchronous Hybrid Learning Spaces.

In our search for new research papers on synchronous hybrid teaching and learning, we found the recent review study of Bülow (2022) who published his chapter on "Designing Synchronous Hybrid Learning Spaces: Challenges and Opportunities" in the eBook on Hybrid Learning Spaces. Understanding Teaching-Learning Practice edited by Gil, E., Mor, Y., Dimitriadis, Y., Köppe, C. (https://doi.org/10.1007/978-3-030-88520-5_9)

This chapter builds on the review conducted at KU Leuven in late 2019 (Raes et al., 2020) described in section 1.

This chapter of Bülow 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.

In Bülow (2022), the following concepts were used to guide the search for literature aside from "hybrid synchronous teaching":

- Hybrid synchronous instruction (Romero-Hall & Rocha Vicentini, 2017)
- HyFlex course design (Abdelmalak & Parra, 2016, 2016; Binnewies & Wang, 2019)

- Synchromodal learning (Bell et al., 2014)
- Synchronous hybrid learning (Butz & Stupnisky, 2016)
- Synchronous online teaching (Bonk, 2020)
- Fusion classroom (Amarin, 2020, p. 797)

A systematic literature review in the databases Web of Science, ERIC and Scopus produced resulted in 32 studies after sorting out duplicates and irrelevant articles (including those that focused only on asynchronous, flipped or blended learning). Results can be read online: https://link.springer.com/chapter/10.1007/978-3-030-88520-5_9

Handbook on Hybrid Learning Spaces. Understanding Teaching-Learning Practice

The Springer E-book, part of the Series on 'Understanding Teaching-Learning Practice' edited by Einat Gil, Yishay Mor, Yannis Dimitriadis and Christian Köppe, touches the topic of hybridity and more specifically how hybridity raised into our educational circumstance in multiple ways during the Covid 19 pandemic. Yet, the work on hybridity did not start in the Covid 19 Lockdown.

In 2016, some of authors were involved in EduPLoP.dk, a design patterns workshop focused on hybrid pedagogy. In 2019, they organised a workshop on Hybrid Learning Spaces at the European Conference on Technology Enhanced Learning (EC-TEL 2019) in Delft. This one-day workshop that explored hybridity in content and in practice brought together 35 participants from across Europe. It continued with a collation of papers contributed to BJET special section on HLS, published in the July 2020 issue (Volume 51, Issue 4).

This book offers a broad approach to Hybrid Learning Spaces, a term that has recently moved from the periphery to the center of educational practice. It adopts an interdisciplinary perspective, which combines pedagogy, technology and space design (including both physical and virtual space). The transversal inquiry-oriented approach looks at considering and connecting values, theory, design and practice.

The book brings together different takes on hybridity from leading researchers and practitioners and thus presents the reader with new insights of how hybridity unfolds at different level.

Interim conclusion and implications for future research, policy and practice (Post covid)

More and more voices claim that the nature and structure of future educational institutions will be hybrid to better deal with fast changing contexts and in order to accommodate the different needs of a diverse learner community. Hybrid learning environments allow learners to attend synchronously online from home, work or when traveling while being connected with on-site students. The idea of hybrid education is not new in the field; the last 15 years, new educational models have been proposed such as *HyFlex* learning and teaching conceptualized by Beatty (2007, 2019) and *multi-access education* conceptualized by Irvine et al. (2013). Covid-19, however, has caused a surge, forcing every institution

into a transition. Many institutions had to switch to what we call emergency teaching as they were not prepared for online models of learning.

While it is still premature to conclude on the impact of the COVID-19 pandemic on education and learning, it is possible through the many studies conducted in different countries to get a first glimpse of the students' experience of online and hybrid education during this particular period. Results show that the forced transition to online and hybrid education led to a significant increase in academic workload which caused more stress for students (Yang et al., 2021). Moreover, although students found advantages in studying alone at home (e.g., time saved by not having to travel), they reported greater difficulty staying task-focused. They also had less opportunities to interact with their peers and experienced higher difficulty to work on group projects.

More than ever we realized that to promote a positive, engaging and optimal learning experience for both on-site and remote students, careful design is needed. Yet to be able to make thoughtful design decisions empirical research is needed about how these new learning spaces are experienced by both students and teachers and to better understand how students are dealing with these new forms of delivery.

Current research (e.g. Raes, 2021) is studying the learning and the teaching space through the lens of the Activity-Centred Analysis & Design framework (Goodyear et al., 2021). Regarding the student perspective, research did not find any significant differences between the levels of presence (i.e. physical and remote presence) in terms of conceptual understanding, yet significant differences were found regarding affective engagement, including intrinsic motivation, relatedness, experienced pressure, cognitive absorption, autotelic experience, sense of presence and sense of belonging. These findings are in line with previous research claiming that on-site students and remote students experience courses differently in the hybrid synchronous situation (Beatty 2007, 2019; Szeto 2014; Zydney et al. 2019). Nevertheless, Raes (2022) provided both quantitative and qualitative evidence that the design of the learning space really does matter to the remote experience meaning that we cannot draw conclusions about the efficacy of hybrid education by just comparing the experiences of in-person and remote students without taking into account the design. Remote can be experienced very differently. Students following the course through livestream without interaction or visibility to the teachers had the lowest engagement scores. In line with this, several students expressed that seeing the teachers and seeing each other really help them maintain closer connections. Yet, having the innovative infrastructure will not guarantee anything. Two-thirds of the students indicated that what a teacher is doing during the course (i.e. epistemic design, e.g. asking a lot of questions, contextualizing knowledge by telling an anecdote) and having the feeling that you are not alone (i.e. set design) are the most important for engendering engagement. Nonetheless, social design and epistemic design are closely interrelated with set design, as a certain teaching space can better support interaction and sense of belonging.

Also for teachers, their teaching space has drastically changed over the course of the past two years. The teachers in study of Raes (2022) expressed that they felt lucky to have experienced the well-equipped teaching spaces as they believe that the spaces supported them in qualitative teaching, and they believe that the facilities of the new spaces serve to engage both staff and students. Yet, we should be realistic in the sense that not every space will have all the facilities included. Next, when having huge student groups, the livestream option will still be used in future education. In these settings it will be important

to incorporate live engagement, e.g. through polls and/or quizzes, and create activate learning scenarios including activities on the individual, group and classroom level. This means that to design supportive hybrid learning and teaching it is crucial to take into consideration pedagogical, social and technical elements as being part of the epistemic, social and set design of a learning and teaching space.

Next to the importance of design, student choice is of particular interest in future hybrid education. In future research, we should get better insight in the factors that affect student choice of course modality and learning environment (who attends where and when?). Moreover, it is also important to question to what extent students have the necessary skills and motivation to deal with the flexibility more and more institutions are offering.

Within the DigiTel Pro project we have the opportunity to merge insights on each of the modes of delivery (Hybrid: IO 2 – Blended: IO3 – Online: IO4) and connect this with the expertise on student readiness, the needs of teaching staff and support staff in an emergency situation (see IO1) and conditions for change management (see IO6).

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