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Hybrid Learning Environments in Universities – how to manage the co-creation process from design to use

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ABSTRACT
An identified need to promote hybrid practices in education puts pressure on transforming university learning environments. Current teaching and learning models and approaches include e.g. hybrid and blended learning, flexible scheduling, and attendance, and the learning environments are changing accordingly. To manage these requirements and processes, siloed practices must be overcome, and this requires the engagement of stakeholders such as faculty and facilities management as well as end-users. The goal of this paper is to understand the transformation processes of hybrid learning environments in universities. The method is cross-case analysis. 6 learning environment transformation-to-hybrid cases are analysed. The case studies are conducted in three Finnish universities in 2018-2020. The results indicate that there are three critical factors in the successful transformations towards technology enriched learning environments: 1. The participatory design process which is integrating the digital and physical architecture to serve user needs 2. The training of users to new learning environments 3. Management of support in the use phase. The research provides practical examples and process descriptions of transformation towards hybrid learning environments for the user-centric design experts, facilities managers, and education designers. The research contributes to user-centric design theories as well as learning environment research. Future studies can be conducted by gathering user experiences of hybrid learning processes in new hybrid learning environments and the challenges residing in them.

Keywords
Hybrid learning environment, Co-creation, Participatory design, University.

1 INTRODUCTION

The need to transform university learning environments (LEs) is based on an identified move towards hybrid practices in education. The places, services and facilities should revolve around the learning and teaching processes, not the other way round. Teaching and learning methods and approaches as well as support services that meet the needs of students, teachers, and staff, with their integrated use of technological tools, include e.g. blended learning, flexible scheduling, and attendance. The requirements of learning environments are changing accordingly. To manage these requirements and processes, siloed practices and push models of services should transform into pull systems, engaging stakeholders such as faculty and facilities management as well as end-users. The process should also entail a future-ready understanding

of sustainability issues from first phases of design imperatives to use and post-occupancy evaluation, in cross-sectional negotiations throughout the process (e.g. Sterner et al., 2019). The goal of this paper is to understand the need and processes of change for hybrid learning environments and embedded and emerging learning-promoting technologies in universities.

2 TOWARDS HYBRID LEARNING ENVIRONMENTS

Contemporary learning has become increasingly technology rich. Technology Enhanced Learning (TEL) research is focusing on new tools supporting learning and teaching. Bligh and Crook (2017) argue that the ones working in the field need to better understand both technology and learning as spatial phenomena and view space as an integral part of the "technology" that might mediate learning. Additionally, TEL also needs to focus on how technology might undermine spatial conventions to benefit learning. For example, they refer to the design of Multi-Display Learning Spaces, where innovative display technologies challenge established, front-facing classroom design repertoires. The display space is used to create juxtapositions of visual materials that support students' verbal contributions in small-group teaching contexts (Bligh & Sharples, 2010). On the other hand, learning is increasingly conceptualised as ubiquitous and continuing, and different informal, even unintentional digital devices and solutions are integrally a part of learning trajectories in terms of sharing and communication, modifying and co-creating, and adapting and innovating (Lai, Khaddage & Knezek, 2013). TEL has been focusing on two-dimensional technology solutions, but the potential of virtual reality (VR) technologies and their features in education have been widely recognized, and experiments and research around them have increased rapidly (Brown et al., 2020). VR applications in higher education are most often used to teach and learn procedural-practical knowledge, declarative knowledge, analytical and problem-solving skills and communication, collaboration, and soft skills (Radianti et al., 2020). Recently, Hakkarainen and colleagues have elaborated on their initial ideas (e.g. Paavola & Hakkarainen, 2005) of inquiry-based learning and how technology can support the learning process (Paavola & Hakkarainen, 2021). Their trialogical learning model holds that technologies not only support but actively participate in the meaning negotiations taking place between the learners and between the learners and the applied technologies. The hybrid environment is an approach to merge physical and virtual spaces and technologies as well as to integrate formal and informal spaces to stress the need to overcome disciplinary and organisational boundaries. The 21st-century campus consists of a range of different general and specialised spaces such as laboratories, libraries, office areas, and lecture halls. Conceptualised and actualized hybrid environments must be rethought on the level of cross-scale space structures by integrating buildings, campuses as well as urban and outdoor spaces (Ninnemann et al., 2020). Learning space is seen as a dynamic entity that is produced by the social and material interactions taking place 'within' it (Law & Mol, 2001), and "the relationship between the dimensions of the environment and people is exactly what counts as the learning environment, through intelligent activities and interactions (Sandström, 2020, p. 20). When linking informal and formal as well as virtual and physical spaces, hybrid environments are emerging in completely diverse ways from the traditional bricks and mortar or clicks and bytes universities to support innovative teaching and learning processes (Ninnemann et al., 2020). Easier said than done, the key to well-functioning hybrid spaces lies in their ability to support seamless F2F interaction where remote participants can integrate their presence and where both parties have a sense of synchronous, equal participation. An unsurprising yet under-resourced factor contributing to the success – both in terms of user satisfaction and in terms of what can and will be achieved – of hybrid environments has been a secured, reliable human support resource that is available at hand (Sandström et al., 2016). In the future, the feasible solution would be for hybrid LEs to be intuitive to use and supportive

for different uses and users, irrespective of the availability of the support resource. Flipped learning (also called inverted learning) has transformed conventional in-classroom learning activities into out-of-classroom activities and vice versa (Betihavas et al., 2016; Karabulut-Ilgu, Jaramillo Cherrez & Jahren, 2018; Lo & How, 2019). Students are responsible for their learning process, and in a typical flipped learning situation they study the subject content of the lecture before class via learning materials such as videos or texts. As the in-class time is not used for lecturing, the students can be engaged in hands-on practices and in other interactive learning activities. These changes in pedagogical approaches towards active learning place a strong demand to refurbish the existing traditional classrooms and auditoriums to meet the needs of both digital and pedagogical solutions. There is a broad consensus in the research literature that learning spaces are inherently social (e.g., Matthews, Andrews & Adams, 2011). Learning spaces are historically, culturally, and socially dependent on the participants who occupy them (Bligh & Crook, 2017). Participatory design processes allow the learners and teachers to be involved in processes of place-making to develop conditions for sustained and meaningful activities, for learning and productive social interaction, this way also increasing a sense of ownership and agency in the LE and in terms of co-created services (Robertson & Simonsen, 2012a, 2012b; Kyza & Georgiou, 2014; Halskov & Brodersen Hansen, 2015; Sandström, 2020). Our approach can be seen to draw analogies to the three perspectives presented by Eyal and Gil (2022), namely *hybrid as blended, hybrid as a space of merging interactions, where technology adds to the space and its dynamic, and hybrid as fluid, as space where the boundaries between informal and formal are reconstrued and the learner is at the centre*. Our study touches upon the different perspectives to hybrid LEs by assuming co-creation as a key approach to construct hybrid LEs. The evolution in design research from a user-centred approach to co-designing is changing the landscape of design practice as well, creating new domains of collective creativity (Sanders & Stappers, 2008). Co-creation of LEs includes many stakeholders and bearers of knowledge of the digital, physical, and social aspects that need to be integrated into the process: to create hybrid environments of the future, more resources will be allocated towards ICT furnishing instead of structural features (Ninnemann et al. 2020). The emerging hybrid environments could become the first step towards sharing resources: digital and physical environments would no longer be funded from separate budgets, allowing synergies to be fully exploited. It is crucial to address the question of *managing* the process crossing siloes: understanding and promoting shared resources during the process and after occupancy. The "co" concepts like co-design to put users and communities at the heart of service design, co-production to allow users to participate in administration and delivery, co-creation to describe the involvement of customers in developing products and processes, and co-construction to describe collaboration and partnership working, are essential to recognize. Co-creative capacity can help us achieve wide-scale socio-environmental impacts including e.g. well-being (Metz et al., 2019).

3 METHODOLOGY AND CASES

The method is cross-case analysis, a research approach to analyse case studies by comparing similarities and differences in the events, activities and processes that are the units of analysis (Ragin 1997; Khan &Van Wynsberghe, 2008). Cross-case analysis focuses on the similarities and differences that may exist between different cases and gathers information from the original cases to refine and develop concepts (Ragin, 1997; 2014; 2015). Six case studies of learning environment transformations toward a hybrid mode were analysed. The case studies were selected from a pool of 12 co-creation case studies that were conducted in three Finnish universities in 2018-2020 (see Sandström & Nevgi, 2021) to represent (1) an experiment and training space for teachers and (2) a learning space for students and teachers (Table 1). The

selection criteria were the purpose of the transformation process, the driver for a need to change a space, and the variation in co-creation methods. The data were gathered by participatory workshops with users, interviews with the design team, and document analysis of e.g. spatial layouts and workshop summaries.

Table 1. Case studies

Case types	Experiment and training space			Learning space		
Case n°	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Purpose	Experimenting and developing hybrid learning and working environment	Experimenting VR-reality – research and showroom	Developing digital skills in innovative learning space	Developing a functional and comfortable learning environment	Providing flexible and easy to use digital and physical learning environment	Providing multi use digital learning environment
Driver	Activity led	Technology led	Activity led	Space led	Technology led	Space led
Size sqm	30	35	97	90	91	102
Renovation year	2019	2018	2019	2019	2018	2019
Picture						

In the case studies, different stakeholder pools participated (Table 2). The focus was arranged based on the expected main user groups, but in Case 5, the focus was more on the technical side of the ICT configurations.

Table 2. Methods used in the co-created cases

Case types	Experiment and training space			Learning space		
Case number	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Co-creation participants	Researchers, ICT-services, Facilities services	Learning services, facilities services	Facility services, ICT-services, teachers	Teachers, learning services, ICT-services, service designer, students	ICT department Learning services, facilities services	Teachers, ICT-services, students
Methods used in the co-creation						
Interviews				x		
Meetings	x					
Workshops				x		
Testing		x				
Use cases						x
Best practice			x			x

Design dialogue	x		x		x	
Walkthrough				x		
Feedback					x	

The SWOT analysis was a tool used in case studies to identify the strengths, weaknesses, opportunities, and threats of the transformation. The cross-case analysis began by reading the systematically produced reports of the case studies by individual researchers. The next step included comparing the similarities and specific features between the SWOT analysis of the case studies. The outcome was discussed in several joint researcher meetings, and the more general guidelines were elaborated.

4 RESULTS

Based on the findings, the strengths pinpointed the importance of flexibility and adjustability in terms of use of furniture and diversity in technology and technical solutions. Case 1 and 4 differed from others by highlighting the well-being and comfort of a space as a strength. Case two was specifically designed for VR and cases 3 and 6 emphasised the possibility of hybrid learning. The main weakness identified in all the case studies was that the full potential in use of devices requires systematic training of end-users. Special problems in space transformation arose due to the structure of the space and the indoor environment conditions, setting some limitations for fluent solutions as it was not easy to adjust technology to the existing classrooms (Table 3).

Table 3. Strengths and weaknesses found for the cases

Strengths	
Case 1	Flexible and adjustable furniture Comfort Scenery boards replace the lack of windows providing natural views Versatile ICT-equipment, GoPro 360 camera, Ceiling-attached fixed microphones Adjustable lightning
Case 2	Open space dedicated especially to Virtual Reality (VR) - place for experiments and demonstrations of different solutions Physical space is adjustable for the requirements of VR technology
Case 3	Modern and flexible furniture Central location on campus Diversity of audio-visual technology in limited space Ordinary lecture theatres and classrooms have similar equipment and dashboards – learning here is making using the technology easier in other locations
Case 4	Adjustable for lectures and group learning Diverse positions: standing, sitting Circadian rhythm in lighting and good acoustics with soft floor carpet increases the indoor environment comfort Two screens enable diverse presentations, the screens above the window wall support the work of the teacher
Case 5	Flexible chairs and tables, easy to move and to relocate

Case 6	Multiple options for teaching and learning Transparency through the windows to corridor Similar capacity as before the renovation Multiple screens, possibility to share screens Diverse possibilities for presentation direction Diverse use cases: discussions, poster presentations, group work, meetings, seminars
Weaknesses	
Case 1	Versatile ICT-equipment requires space Using the devices to their full potential requires skills and training Instead of digi-pedagogical training one focuses on technical training only Mere GoPro 360 from bird perspective is not usable in hybrid teaching
Case 2	Virtual Reality is a trending technology and not yet known thoroughly – requires a lot of marketing for students and teachers
Case 3	The amount of technology is also a weakness of the place – there are too many screens It is not easy to use in basic education and it is not meant for it
Case 4	The structure of the space limits the flexible arrangements of furniture The full potential of the use of devices requires training Little amount of natural daylight
Case 5	Part of the equipment and screens too advanced and non-intuitive, limited use
Case 6	The space is constantly occupied due to capacity and the use is not always for new purposes. The location on campus is not central, it is not easy to access & there is no clear ownership, and the space is not very well taken care of It is easy to forget to switch on the ceiling microphones To manage all equipment takes some time

Five case studies shared the same opportunity for organising hybrid teaching and learning by using the versatile devices and digital technologies of the space. Case study 2 differed from other case studies, as the main purpose for the space development was to create a room for effective use of Virtual Reality. All the refurbished spaces had attractiveness factors for different stakeholders. (Table 4)

Table 4. Opportunities found for the cases

Opportunities	
Case 1	Space provides multiple possibilities to train and develop digi-pedagogical skills. The space functions as a meeting room for face-to-face and hybrid and remote meetings. The space is a room for research group collaboration, and it offers potential to investigate group work and communication.
Case 2	The wow-effect of Virtual Reality can increase the interest of teachers and students in innovative technology. Modern technology advances learning and thinking and provides opportunities for new exercises.
Case 3	The development of space was based on sufficient resources. The synergy with places close by can provide resources for future development. The space can be used for other purposes too and it is easy to add innovative technologies. It is a peaceful place to test technology compared to lecture theatres. The place is a meeting place for digital mentors, and it is also a meeting place for teachers. The place can also be used for teaching purposes, and it can support all campuses of the university.

Case 4	The place is transformable into two smaller learning places by the removable wall.
Case 5	The space can be used in diverse group working situations, there can be more presentations simultaneously on many screens or only one presentation on many screens.
Case 6	It is easier to join remotely through video conferencing. The active participation of students is enhanced by sharing screens from their own laptops. Space can be used to learn digital teaching skills. The space is adjustable, and it provides enough room for diverse experiments in using digital solutions. The space can also attract external stakeholders of universities to organise events on campus.

The common threat in all six cases was the lack of support in the use of the hybrid solution. The lack of support in the use of the space leads to a situation where the potential of digital technologies is not fully taken to use. (Table 5)

Table 5. Threats found for the cases

Threats	
Case 1	Limited use because users cannot use the equipment.
Case 2	The continuity of the development is not clear, and the ownership and funding of the space are still open.
Case 3	If the space is not found by teachers to experiment and train, it is not serving its purpose. It is difficult to get teachers to use it without external guidance. Patience with the new space to new use is required – it is too easy to start to use the space differently without the full potential. Full potential and use require input and marketing.
Case 4	The potential of the space is not fully used, because the training of the use of the space was not resourced during the planning phase.
Case 5	Less communication in the scale of the learning space depending on the way the space is used.
Case 6	The skills will and time for new pedagogy in the new space – the threat is that the traditional ways to teach are still strong. There is no time to learn to use space, especially if the instructions are not clear. The space needs to be left to default settings to be ready for the next user and new settings.

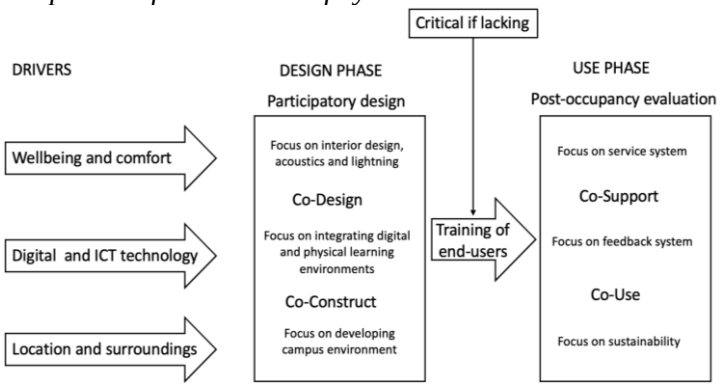
All case studies implemented co-design and co-creation in developing and refurbishing the target room to meet the requirements of the active learning environment. Cross-case analyses about user participation indicated that there was more than one method used in all but one case. The most frequent design dialogue (and meetings) seems to focus on the physical solution and co-creation on it. It is also typical to use benchmarking for best practices. There are many methods used (interviews, workshops, testing, use cases, walkthrough), but one would benefit from a more systematic framework in using them. The management of the design phase differed in the case studies. Only one of the case studies continued user involvement by gathering systematic feedback. The design drivers of the refurbishment of the space were threefold: Well-being was a driver in two case studies (case studies 1 and 4), where the selected classrooms were uncomfortable without natural light and with bad acoustics. The role of the interior architect was particularly important in managing the design phase. Case studies 2 and 5 had a driver in the integrated co-creation process to refurbish the space for the use of innovative technology (e.g. VR). The importance of the role of ICT experts in managing the design phase was identified. For case studies 3 and 6, the location of the space was the design driver. The intention was to re-design the learning environments to make them more attractive

for students and teachers. The location of these spaces was not optimal, and so in managing the design phase, the various pull factors were considered to improve the attractiveness of the space.

5 CONCLUSION

The user-centric approach is extending towards co-creativity (see Sanders; Metz). The "co" concepts co-design and co-construction require counterparts at the use-phase, namely co-support and co-use. All the cases showed that there was less emphasis on managing the user involvement at the use phase, Figure 1.

Figure 1. Managing the phases of co-creation of hybrid environments



In the present study, three different drivers for refurbishing the teaching and learning spaces were identified: well-being, new digital technology, and location of the learning environments. Depending on the driver for the transformation process, different stakeholders took part in the co-design process and influenced the outcome of the refurbishment. All the case studies highlighted that if there was no training of end-users and in the use phase no support was provided to end-users, the potential of the new learning environment was not fully utilised (See Figure 1). Managing the user involvement in this context refers to post-occupancy evaluation and user support through e.g. training to use the facilities. This kind of management is often not resourced, and there are seldom plans for post-occupancy user engagement through training and support. Furthermore, the results indicate that a participatory design process, combining digital and physical architecture to serve user needs, is essential. However, for a successful outcome, representatives of all potential end-users and experts should be identified and involved in the co-creation processes. In the use phase, integration of various service systems (such as booking system, and end-user support system) should be considered for further development of the refurbished space. The feedback is essential, and collecting it should be systematic. Like the scholars state, co-created services are important and we propose that the co-support and co-use are ensuring the potential of full use of the transformed spaces. The process can be at its best a learning process for users and stakeholders, and there should be a systematic way of collecting the learnings for future developments. This provides avenues for future studies. The selected case studies represent the growing demand to increase the diversity of modern technologies integrated to and supported in learning environments, although the number of cases is limited. The case studies were realised before the push to all-online studies, and they were the forerunner hybrid spaces to be used and scaled further. The user-centric design among experts, facilities managers, and education designers as well as users played a different role in the cases but provided a rich insight to different methods for co-creation. The continuity of theories from design phase to use phase bring new insights both to design science and workplace management research.

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