ORIGINAL ARTICLES

Teaching Novice Teachers to Enhance Learning in the Hybrid University

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Abstract

Hybrid learning spaces are often associated with 'blended' education and defined by the presence of a mediating technology. In this paper, we shift the focus from technology to practice in the search for a relationist perspective that understands hybrid space as emerging from a sociomaterial assemblage. In this perspective, learning and teaching involve blurred boundaries and spatiotemporal configurations in a context of radical uncertainty. The paper presents a qualitative study of an ongoing project called Teknosofikum, a course/concept for the professional development of novice higher-education teachers in Denmark. The project addresses the complexity of distributed learning in (post-)pandemic hybrid spaces and times. It aims at generating imaginative pedagogies through the use of technology while also nurturing ontological aspects of the teaching profession. The paper presents and discusses data from the first iteration, which included co-designed processes of prototype content development and a mini-trial with seven course participants. Two key findings about teacher professional development emerge from the study. The first is the need to focus on multiple and situated teaching activities, providing a bridge between learning theories and educational practices. The second is the importance of knowing-in-practice, rather than acquiring knowledge, to create space for imagination in teaching with technologies and face up to the dynamic evolution of higher education.

Keywords Hybrid learning · Technology education · Teacher professional development · Novice HE teachers · Sociomaterial theories

Introduction

The sudden digitalisation that occurred with the Covid-19 pandemic has shown us that one of the most complex and daunting challenges for higher education teachers is managing the ongoing transformation of learning environments (Carvalho et al.

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2020; Darling-Hammond et al. 2020). This entails identifying emerging technologies and platforms (EdTech) with potential relevance for teaching and customisation and providing students with high-quality learning experiences (Rapanta et al. 2020; Ní Shé et al. 2019). It also requires institutional and organisational strategies to foster teacher sensitivity to expanded possibilities beyond space–time boundaries (McGregor 2003) and conventional face-to-face lectures (Hodges et al. 2020).

However, if we assume that learning is not merely a cognitive action but the result of multiple interactions between mind, body and the environment (Pischetola and Dirckinck-Holmfeld 2020), the main current challenge for higher education (HE) is, perhaps, the reconceptualisation of the learning space itself (Hilli et al. 2019). In fact, EdTech and online education cannot be seen simply as 'enhancements' of teaching and learning (Castañeda and Williamson 2021); rather, they must be seen as elements that modify the whole educational ecosystem (Pischetola and Miranda 2019). A keyword that emerges is hybridity, a theoretical construct that we use here not merely to define 'blended' spaces but to indicate a human-social-technological spacetime from which learning arises (Cohen et al. 2020; Ratto et al. 2019). In this study, we focus on what hybridity means from a teacher's perspective, taking into account the blurring of boundaries between physical and virtual spaces, private and public spaces, personal and professional life and embodied and rational experiences.

Fostering learning in manifold spaces and creatively exploring their potential requires a variety of teaching competencies and strategies. In fact, while teacher-learner interaction has become more and more automated, students' sense of belonging within HE increasingly depends upon the 'human touch' (Cureton et al. 2021), affectivity (Hickey-Moody 2013) and teachers' care-filled receptiveness (Dall'Alba 2020).

This paper presents a qualitative study of an ongoing project called Teknosofikum, funded by the Danish Ministry of Higher Education and Science, which aims at supporting novice HE teachers in coping with these challenges. The project has a 3-year duration (May 2020–April 2023) and involves four partner institutions in Denmark: IT University of Copenhagen; Royal Danish Academy—Architecture, Design, Conservation; University of Copenhagen Faculty of Law; and Design School Kolding. The approach taken in the course development follows design-based research, a method that combines research with the design of learning environments through several iterations. In what follows, we present the results of the first iteration (pilot phase), including content development and the first mini-trial, which had seven course participants.

The research question driving this study is: *How can a professional development course enhance HE teachers' practices in hybrid spaces?* To address this question, we adopt a sociomaterial perspective with a focus on complex, changing relationality (Massey 2005) between teachers and learners in hybrid spaces and its materialisation in specific actions and attitudes (Heinsfeld and Pischetola 2019). The motivation for this theoretical grounding is threefold.

First, a sociomaterial approach has at its core *hybridity*, as it refers to blurred boundaries (Mol 2002), negotiations among groups (Bijker 1995) and 'webs of relations' (Fenwick and Edwards 2014) in agentic assemblages (Latour 2005). As such, it can offer a valid alternative to deterministic and instrumental perspectives (Feenberg 2017) as well as essentialist views (Gallagher et al. 2021; Lamb and Ross 2021) that take

technology as the main driver for learning (Johri 2011; Nespor 2012). In this way, the adjective 'hybrid' refers to the assemblage of tools, platforms, resources, pedagogical approaches, institutional arrangements, power structures, norms, discourses and agentic tensions that shape the 'materiality of learning' (Sørensen 2009). This focus on hybridity also highlights challenges and opportunities produced in the encounter of 'learning, working, playing and living' (Cohen et al. 2020) that have been widely exposed by the pandemic experience of emergency online teaching (Gourlay et al. 2021; Pischetola et al. 2021; Swerzenski 2021).

Second, sociomateriality expresses itself through the *practice* in which technology is embedded, that is, the space in which the social and the matter are 'constitutively entangled' (Orlikowski 2007). The use of the adjective 'material' is chosen to describe an aspect of technology that is 'intrinsic' to it, an inherent property that does not depend on the social or cultural context (Leonardi 2012). This includes of course the physical matter that comprises a technological artefact, but also the form and purposes given to it (Kallinikos 2011), which might endure across contextual and situational differences (Faulkner and Runde 2011). However, the material aspects are less important than 'how the material is configured in practice and enacted in the moment' (Johri 2011 211). In fact, it is acknowledged that technologies—like any other object—continue to evolve and change through interaction with human actors, so that we can think of them only as 'stabilised-for-now' (Orlikowski 2000 411). Gad and Jensen (2014) stress that the term 'practice' refers at once to conceptual and empirical issues, and as such it can be used as a tool for analysis. This is the reason it has become a central focus in Science and Technology Studies.

Third, a sociomaterial approach will enable us to frame HE teachers' professional development as rooted not only in doing but also in *being* (Dall'Alba 2009). Educational research has shown that teachers always bring some aspects of themselves into their pedagogies (Bell 2021; Pischetola 2020), along with institutional culture and contexts (D'Cruz 2021). They bring epistemic beliefs and values, which are mostly implicit in their pedagogical doing (Tondeur et al. 2019). Proceeding from this premise, we can understand academic identity as an 'ongoing project' (Barrow et al. 2020) that sometimes requires resistance to structural pressures, as teachers' actions and the constraints on them are constantly reconfigured by the many agencies at work, including institutional, organisational, political and economic relations (Hasse 2017).

A professional course for HE teachers has to take all these factors into account in order to (i) engage with the complexity of distributed learning (*hybridity*), (ii) generate productive and imaginative pedagogies (*practice*) and (iii) nurture the ontological aspects of the HE teachers' professional life (*being*).

Learning Within Hybridity

Over the past two decades, a significant public investment has been made in HE infrastructure and course offerings, generating the need to reframe the concept of 'learning space' (Boddington and Boys 2011). Mulcahy et al. (2015) argue that despite the general acknowledgement that space is in itself an agent of change,

which generates new practices, learning spaces are still under-researched and under-theorised. According to Temple (2007), this is due to the somehow problematic definition of what a learning space is. A critical analysis of campus design shows, for example, that physical spaces are often conceived without considering teaching and learning effectiveness. Architecture-related studies, says the author, tend to disregard the fact that universities are a space of interaction and learning. This is reflected in a disconnection between the physical space and the community space. To the contrary, Kuh et al. (2005, 93) argue that a learning space is where the physical and the emotional intertwine in creating a 'sense of place' for members of the community. This view is echoed in recent literature on the 'multiple spatialities and enactments' of distance education and mobility (Bayne et al. 2014 571), where relations are unbounded by time and geography (Mulcahy 2018; Tietjen et al. 2021), and learning spaces are deeply affected by mixtures of material and digital tools (Goodyear 2020).

In this section, we seek to briefly ground different conceptions of learning spaces in learning theories, with the aim of building our concept of learning space on a sociomaterial theory of learning.

Historically, most learning theories were created at the beginning of the twentieth century from the psychological perspective of the individual subject (Goodyear and Carvalho 2014). Such an input–output understanding of learning has its roots in behaviourist theory and its guiding influence on educational technology throughout the twentieth century (Selwyn 2016). This view of learning as a product underlines the importance of both a quantitative increase in knowledge and the idea of storing information that can be reproduced as necessary, as well as the related methods of memorising and retaining information (Säljö 1979).

In the last decades, the research focus has gradually shifted from learning as a product to learning as an ongoing process of rational sense-making. Selwyn (2016) points out that this is a common ground of interest for cognitive psychology and technology-based education. In HE, he argues, many technology-based learning environments, such as work-related simulations and intelligent tutoring systems, follow cognitivist lines. These approaches were later criticised for conceiving learning as an individual process and losing sight of social aspects of human nature. Schunk (2012) offers a good example of this critique in the context of language acquisition. Although human beings are provided with a vocal apparatus, they are incapable of producing language by themselves, individually. They learn from social interactions with parents, teachers and peers, through what Vygotsky (1978) has called the zone of proximal development.

Johri (2011) explains that the first appearance of a notion of sociomateriality in relation to learning technologies can be found in sociocultural theories, such as Lave and Wenger (1991) situated learning theory and Engeström (2001) activity theory. By stressing the importance of interaction as a key element for supporting learning, sociocultural theories have tried to describe intelligence, as well as learning and knowing, in a wider and more expansive way. From this point of view, collaborative processes and the actions of others—e.g. interaction, feedback and scaffolding—are considered part of the individual learning process (Vygotsky 1978). A commonality of these perspectives is the understanding of learning as 'cognition in context'

(Barab and Squire 2004). This means that knowledge, learning processes and situated settings are not addressed as isolated or separate variables. The complexity of sociocultural variables and the unfolding of procedures are taken into account in relation to real-world practice while a process of 'learning with' the context occurs (Nørgård 2021). These approaches have also promoted a focus on the uniqueness of any given learning trajectory, providing support to what diSessa and Cobb (2004) call 'ontological innovation', which involves combining the study of the learning process with the means that support it.

Pischetola and Dirckinck-Holmfeld (2020) underline that sociomaterial theories, generated within the Science and Technology Studies tradition, feminist new materialism and posthumanism, have offered new perspectives on learning that may be even more powerful in overcoming dualisms than sociocultural approaches. In fact, a sociomaterial approach shifts the research focus from EdTech and its uses toward mutual relations among different agencies in the assemblage. Agency is extended to non-human actors by focusing on heterogeneous networks where all the components participate in the production of knowledge. In this sense, EdTech is not merely used by human actors but also has an active role in the learning process.

Following the same line of thought, Mulcahy et al. (2015) identify two main trends in education, a (predominant) 'realist' perspective and a 'relationalist' one. The realist reasoning takes a point of departure in space as defined by entities, or things, and reflects the modernist idea that space 'has an *essence*' in itself (Mulcahy et al. 2015: 578), with specific qualities that inform and shape its contents. In contrast, the relationalist perspective, which is in dialogue especially with actor-network theory (Law 1992), takes into account social factors concerning the occupation and uses of space. In this view, educational spaces are no longer containers for learners' activities; rather, space is 'made through action' (Mulcahy 2006). In sociomaterial terms, a learning space is made by material, digital and social relations that shape the formats (Lamb and Ross 2021) and boundaries (van de Oudeweetering and Decuypere 2019) of the learning experience. Thus, learning is configured as 'situated and embodied' (Networked Learning Editorial Collective (NLEC) et al. 2021), while at the same time being 'distributed' (Ferrara and Ferrari 2017) and 'emergent' (Biesta 2010). New configurations of learning spaces mean new actors involved and new possibilities for the learner.

Teaching in the Hybrid (Future) University

Teaching in hybrid spaces is a complex undertaking (Gerbic 2011), and research has shown that there are several challenges to take into account.

First, we need to acknowledge that rethinking pedagogies requires time, while HE teachers need to develop strategies to cope with rapid and constant change in technologies. In online teaching, for example, there is a stronger need for participatory strategies than in face-to-face lessons, and emergency remote teaching during the pandemic has shown how physical lessons cannot simply be translated into a different format (Carvalho and Yeoman 2021). Despite a tendency to consider digital practices as disembodied, they cannot be separated from the physical

context in which the learning engagement takes place (Gourlay et al. 2021) and from the emotional aspects that learning entails (Pischetola et al. 2021).

Second, transforming pedagogies is a process that involves personal investment and motivation for the change in mindset (Englund et al. 2017). Accordingly, the experience acquired by teachers during the Covid-19 emergency will have an impact not only on post-pandemic practices but also on teachers' professional identities. This process also entails the negotiation of conflicting views within the university, corresponding to different values driving imaginative and otherwise desirable futures (Barnett and Bengsten 2020). Several scholars defend critical, emancipatory educational traditions, insisting on the intertwinement of humans, technologies and collaborative joint engagements in valued activities (Gallagher et al. 2021; Networked Learning Editorial Collective (NLEC) et al. 2021). Others argue that ethical practice, conceived as affective encounters, is at the core of academic work and post-anthropocentric educational processes of knowledge production (Taylor 2019). These contributions represent attempts to mobilise universities in alternative directions, in contrast to perspectives of efficiency and institutional accountability, by focusing on discourses of 'care, support and criticality' (Di Napoli 2014) and by enhancing different 'ways of being university teachers' (Dall'Alba 2005). Based on these reflections, which concern both academic *doing* and *being*, how can we prepare novice teachers for the present and future hybrid university?

In recent years, a growing body of studies have committed to expanding research on HE teacher professional development beyond individual skills and capabilities (Bocconi et al. 2016; Mathiasen 2019). Barnett (2007), for example, claims that HE teachers need to be prepared for the uncertainty (and darkness) of the future university. The author starts by asking: 'what is it to learn for an unknown future?' (Barnett 2004: 247). Despite the fact that learning has always related to an unknown future, Barnett notices that this perspective has never been considered in curricula and pedagogical decision-making in HE. The reason this is crucial, he argues, is that in our time individual ways of being in the world are changing constantly, as are the interpretations of such ontological matters. This view is in line with a sociomaterial perspective on the world, which questions closure into certainties (Latour 2005) and considers complexity to be part of life. In teaching practices, the element of uncertainty is particularly relevant as the unfolding of multiple possibilities makes actions, choices and sense-making processes constantly unpredictable (Fenwick 2011). That is why, according to Morin et al. (2003), teachers should always be able to improvise or, in other words, to adapt to the non-linearity of a complex system. Several scholars refer to this attitude as risk-taking (Howard and Gigliotti 2016; Le Fevre 2014). However, within a sociomaterial position, it is more accurate to contemplate what a large range of contexts, materials and practices engender in terms of uncertainty. With respect to this, Callon et al. (2001) highlight an important difference between the two notions of risk and uncertainty. The first designates a well-identified event that has some probability of taking place and is perceived as a danger. A rational process of decision-making follows the risk, based on available knowledge. In contrast, uncertainty relates to many possible events that are not well identified.

Drawing on these insights, we understand the professional development of HE teachers as a process of enactment, related to uncertainty, that aims at creating empowerment (Pischetola 2021). In the next section, we present a project that approaches teaching in these terms, as an imaginative profession in radically uncertain times.

Teknosofikum Project

Teknosofikum is a 3-year project (2020–2023) funded by the Danish Ministry of Higher Education and Science to address the professional development of novice teachers in technology education. Four partner institutions—IT University of Copenhagen, Royal Danish Academy, University of Copenhagen Faculty of Law and Design School Kolding—are working together for these 3 years to realise a course/concept that will involve a total of 500 in-service teachers from all over Denmark. The project is organised around three iterative cycles of design and analysis, wherein course participants are expected to assess formats, contents and pedagogical proposals. The final product is a modular course created in two formats: (1) blended facilitated and (2) online self-study.

As to the project's overall scope, the course aims to motivate HE teachers to include aspects related to technology education in their teaching and to engage them in doing so. It is important to stress the meaning given here to technology education (TechEd), in contrast to educational technology (EdTech). Technology education is understood as facilitating not merely the acquisition of new knowledge about possible uses of digital tools and platforms (Hansbøl 2019) but rather a deeper understanding of the way technology shapes and co-creates society (Dakers 2006), with the goal of enacting pedagogical practices that are in line with situated teaching purposes.

This perspective invites us to consider Teknosofikum as a laboratory of 'theory into practice' (Lenz Taguchi 2011), that is, to adopt a sociomaterial pedagogical vision/action. As such, the project is grounded in a practice-based teacher education paradigm (Ball and Forzani 2009), in which HE teachers share their experience, acquire new knowledge and enact it in their teaching. This idea is in line with the understanding of professional development as the intertwinement of knowing, being, and doing (Dall'Alba 2005).

Concretely, the project addresses three scopes (see Table 1 below) with a focus on (i) the role of technology in hybrid learning spaces, (ii) existing and new pedagogical practices and (iii) the teachers' pedagogical beliefs and attitudes. Each scope is pursued in the course with activities aiming at reflecting, acquiring new knowledge, and enacting it in teaching.

The project starts from the assumption that student learning in hybrid spaces is fostered by a critical relational pedagogy (Ulmer et al. 2020). Therefore, it seeks to focus on sense-making practices, participatory inclusive strategies and academic networks of 'communities of inquiry' (Castro 2019; Garrison et al. 2000).

Table 1 Teknosofikum scopes/actions related to three elements of teacher professional development

Teknosofikum scopes/actions			
Hybridity (learning space)	Reflect on sociomaterial entanglements of learning spaces and the different roles of technology	Acquire new knowledge about technology (e.g. computational trends, ethical dilemmas and critical issues)	Understand the agentic power of technology in society
Practice (pedagogy)	Reflect on one's own pedagogical knowledge	Acquire new pedagogical knowledge (e.g. activities, dynamics, tools)	Enact learnt practices in a new situated context
Ontology (identity)	Reflect on one's own pedagogical beliefs, intentions and actions	Acquire/deepen critical and relational attitudes (e.g. affectivity)	Face uncertainty, accept openness and engage in risk-taking

Materials and Methods

Teknosofikum is conceived as an application of design-based research (DBR), a methodology that combines the design of learning environments with research on the learning outputs occurring in the designed setting (Cobb and Gravemeijer 2008). DBR aims at investigating both the process and the means through which learning occurs, having the character of an intervention through iterations. Sociomaterial theories can support a design-oriented project in that the focus on materiality is never separated from enabled uses, constraints or organisational and social practices around it (Leonardi and Rodriguez-Lluesma 2012).

Reeves (2006) stresses that DBR can be an effective model for inquiry in the field of educational technology, as its protocols require intensive collaboration with developers and practitioners. Iterative activities can support educational designers in dealing with many ambiguities, risks and uncertainties while experimenting with innovative educational design. Moreover, adopting DBR to study the presence of technologies in education enhances a socially responsible approach to research (van der Akker 2003).

Cobb and Gravemeijer (2008) suggest a three-phase educational design research model, the phases being (1) *preparation*, (2) *experimentation* and (3) *retrospective data analysis*. The first phase is the most challenging as it requires clarification of the instructional goals, a definition of an envisioned learning trajectory for the participants and a theory of learning. The designed learning setting is understood as 'a case of a broader class of phenomena' (Cobb and Gravemeijer 2008: 69), which will inform the researchers about new possibilities for future learning design. This idea is referred to as 'minimal ontology' by Barab and Squire (2004), who underline that research tools and methods need to be adapted to the theoretical focus of the study from this very first stage onward.

A complex research plan comprising different instruments, both quantitative and qualitative in nature—entry/exit survey, participant observation, focus groups,

semi-structured interviews and document analysis of teaching plans—will allow for the assessment of Teknosofikum at each iteration. In line with the DBR methodology, instruments and techniques will also evolve throughout the project as part of the iterative processes of data collection and interpretation in a process of ongoing testing and revising (Cobb and Gravemeijer 2008). Furthermore, the body of data produced will be useful at the end of the project for conducting retrospective analysis by reconstructing the rationales for specific decisions about the course design. For the success of an application of DBR, it is of great importance that all steps be reported in detail, including the evolution in the researchers' conceptualisations, interpretations and assumptions. Ultimately, this research is also meant to find future-oriented solutions based on reported empirical findings.

First Iteration—Pilot Phase

In this section, we describe the conceptual work and operational steps that have guided the first iteration of Teknosofikum, following the phases suggested for design-based research (retrospective analysis is presented later as discussion). The research question driving this study is: *How can a professional development course enhance HE teachers' practices in hybrid spaces?*

Preparation

Between September 2020 and March 2021, the gathering of empirical data proceeded alongside content development and production, which is running in a co-designed mode, involving three educational designers, seven academics qualified as subject experts and two researchers. The process of content design and decision-making was also followed by the project group, which is composed of eight academics equally divided among the partner institutions.

The first challenge was to translate a sociomaterial understanding of hybrid learning spaces into a concrete *curriculum* proposal for Teknosofikum. In design-based research, curriculum enactment passes through different dimensions (van den Akker 2003): the *intended* curriculum contains an ideal proposal based on an underlying learning philosophy; the *implemented* curriculum contains both the interpretations perceived by users and the operational curriculum as enacted in teaching activities; and, finally, the *attained* curriculum includes the experiences and the learner outcomes. Curricular decision-making is generally a complex procedure, which depends on a lengthy, iterative process carried out by many different participants. It is important that the final decisions be consistent, harmonious and coherent (McKenney et al. 2006).

This process for enacting Teknosofikum's curriculum started from a draft of an intended course/concept in eight modules (for a total of approximately 37 hours), which was approved by the Danish Ministry of Higher Education and Science. The initial contents included in the project draft were reshaped in a first round of discussion among participant designers, ultimately forming a curriculum with six modules (see Table 2).

Table 2 Teknosofikum modules

	Modules of Teknosofikum
0	Technology Education for HE Teachers (introductory module)
1	Computational trends, digital design and the shape of knowledge
2	Hybrid teaching and learning ecologies
3	Technology and regulation
4	Digital design, methods and processes
5	Data analysis and representation
6	Computational thinking and worldmaking

Contents of the first three modules were included in the first course prototype and developed between January and March of 2021. Given the complexity of translating specific topics of a subject domain into a format that would be accessible to non-expert HE teachers from other disciplinary areas, a model for content design and development was conceived. Its structure resembles a flower, with the subject matter as the central circle and the pedagogical activities as the 'petals' around it (see Fig. 1). These activities were divided into six areas, based on existing models such as the Conversational Framework (Laurillard 2013), the ABC Learning Design (Young and Perović 2020) and the Carpe Diem model (Salmon and Wright 2014).

Subject-matter experts participated in brainstorming workshops with educational designers, with the intent that the flower model would function as an inspiration to align content, target and activities. The outcome of this process was a design of six topics for the first three modules.

A second step of the preparation phase—albeit contemporary with and entangled with the curriculum design—was to establish a *learning trajectory* for Teknosofikum. Drawing on Wenger's theoretical model of communities of practice, Oliver and Carr (2009) stress how learning trajectories are related to social processes of learning, which allow individuals to become members of communities. The authors suggest considering the relevance of such processes when designing curricula, beyond the mastery of content and skills as main learning outcomes. Cobb and Gravemeijer (2008) highlight that the research literature provides limited guidance about the formulation of a learning trajectory. The authors suggest proceeding through conjectures based on the experience of the team of researchers and keeping the process open to further revision, refutation and reconfiguration. They stress that it is also useful to adapt and improve existing designs from other studies, as was done for Teknosofikum with the flower model.

The project was conceived and approved by the Ministry as having two distinct final outcomes: a 'blended' facilitated course and a self-study online course. However, both the experience of Teknosofikum educational designers and the literature on teacher professional development reviewed in the first 6 months of the project suggested that a self-study online course would prove less effective than a blended course, as lack of motivation and a substantial drop-out rate are reported as general challenges of online courses (Robinson and Hullinger 2008). Being regarded as
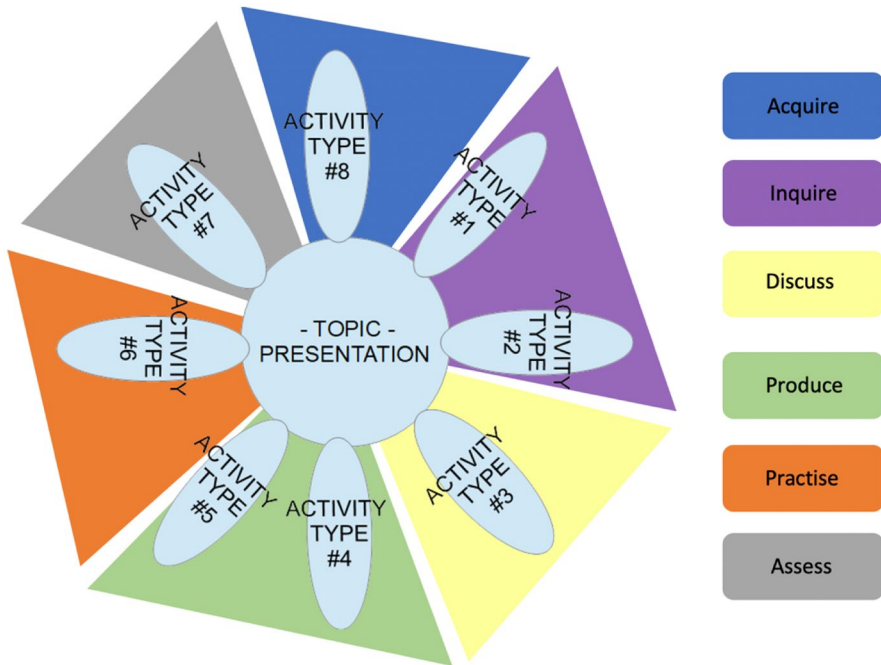
Fig. 1 Flower model for content design/development with subject experts

more challenging, the self-study format was developed first, to be tested in the first trial with course participants. These participants were also asked to contribute to the design of Teknosofikum by suggesting engaging activities and what they saw as the most effective dynamics of active learning in hybrid learning spaces.

Experimentation

In May 2021, evidence was collected during a first mini-trial, in which seven HE teachers from the four partner institutions tested the first prototype self-study online course. The recruitment of participants followed different paths, which they described in the initial survey: four of them were 'curious about a course for HE teachers', two took the course as 'part of another professional development program' and one chose the option 'I was forced by my institution'. The sample included three associate professors, one assistant professor, two part-time lecturers and one post-doctoral researcher. All the participants had been teaching online from the initial breakout of the pandemic in March 2020 until the time of data collection in May 2021.

The estimated time needed to complete the course was 3 hours. Along this trajectory, the course participants were to answer two surveys, rate the topic presentations (as to relevance, format, length and activities) and participate in a group interview after the trial.

The initial survey (consisting of 18 questions) was divided into three sections, respectively regarding participants' perceptions of (a) educational tools and platforms (EdTech), (b) the roles of technology in society and education (TechEd) and (c) expectations of Teknosofikum.

The final survey (consisting of 13 questions) addressed the same topics, summarising for the participants what the core foci of the course were and concentrating on their feedback about interesting topics, formats and proposed activities.

The final interview was organised into two parts, starting from a sparking activity in which the course participants chose three keywords to describe good teaching in hybrid spaces. In this first component, the interviewer also clarified the meaning we are giving to 'hybridity' in Teknosofikum, not considering it as synonymous with 'blended', thereby stressing the role of technology, but focusing rather on blurred boundaries between physical and virtual spaces, private and public spaces, personal and professional life, and embodied and rational experiences.

After this initial brainstorming, the following questions were addressed:

1. What competences will teachers need in the post-pandemic university?
2. How can a professional course in technology education be relevant for HE teachers?
3. How was your experience with Teknosofikum?

Three interviews were held online with the seven course participants, to allow for enough speech time for each participant.

Results

The initial survey completed by course participants shows a trend toward feeling comfortable using online tools and Internet platforms, along with a general perception of educational technologies as opportunities for both learning and teaching (see Fig. 2). No answers fell in the category 'disagree' or 'strongly disagree'.

Course participants also showed a high awareness of the need to include critical reflections on the mutual shaping of technology and society, as Fig. 3 below shows.

Regarding expectations of Teknosofikum, most of the answers fell into the categories 'available tools and platforms' (30%), 'potential activities to use with students' (30%) and 'discussions about pedagogy' (20%). To a much lesser degree, course participants expected coverage of tech trends and critical discussions about technologies.

The participants attended the course in the first week of May 2021 and were very active in all the required asynchronous interactions, such as posting in forums and wikis (see an example in Fig. 4).

During the interviews, they reflected on some issues that had emerged in forums—in particular, the restrictions imposed by virtual space, where the students' bodies cannot be 'read' by teachers to understand and 'feel' the classroom. A sense
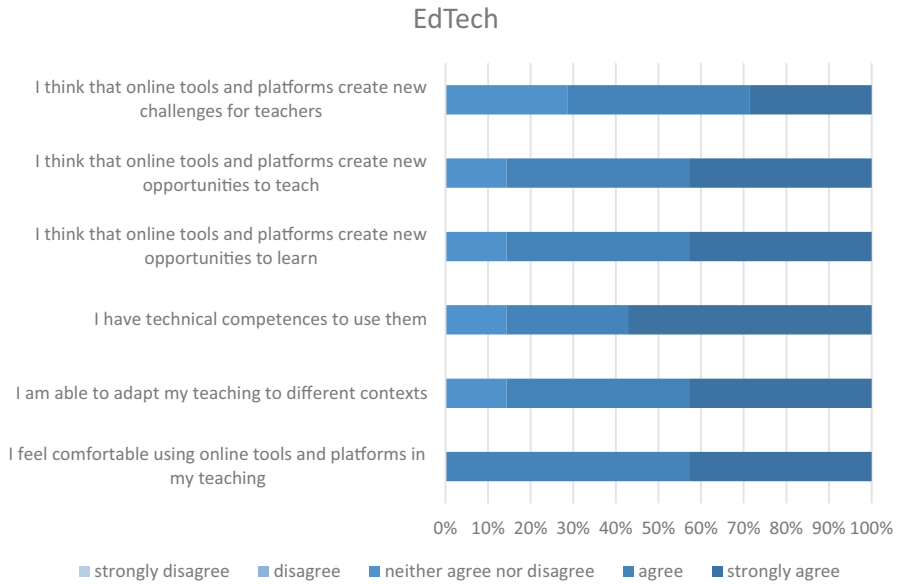
EdTech

I think that online tools and platforms create new
challenges for teachers

I think that online tools and platforms create new
opportunities to teach

I think that online tools and platforms create new
opportunities to learn

I have technical competences to use them

I am able to adapt my teaching to different contexts

I feel comfortable using online tools and platforms in
my teaching

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

■ strongly disagree ■ disagree ■ neither agree nor disagree ■ agree ■ strongly agree

Fig. 2 Course participants' perceptions on their use of online tools and platforms (EdTech)

of uncertainty was underlined several times, especially by the most experienced
teachers. The following interview excerpt sums it up:

> If I'm in a classroom, I believe I always know how it went. I know when they
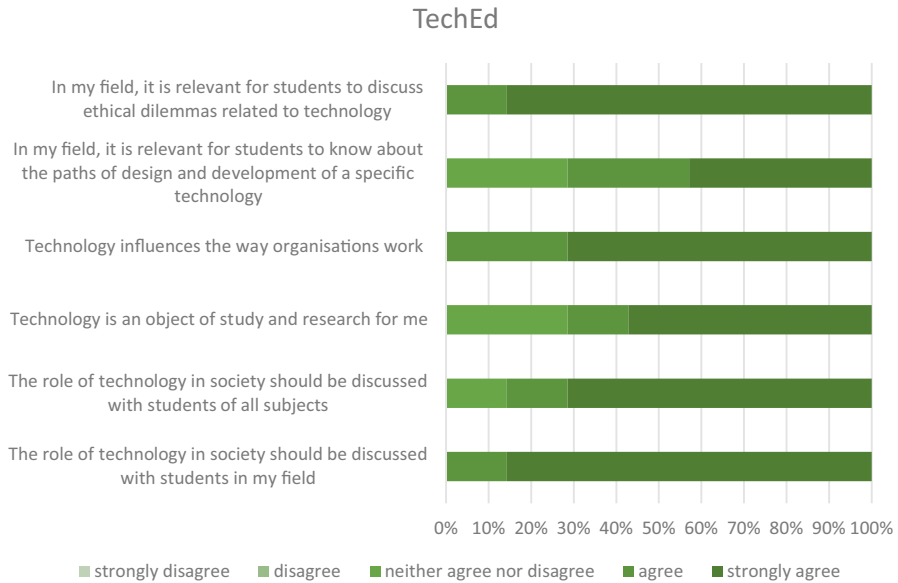> liked it, I know if it was a good class or not, but in the online version, after I've

TechEd

In my field, it is relevant for students to discuss
ethical dilemmas related to technology

In my field, it is relevant for students to know about
the paths of design and development of a specific
technology

Technology influences the way organisations work

Technology is an object of study and research for me

The role of technology in society should be discussed
with students of all subjects

The role of technology in society should be discussed
with students in my field

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

■ strongly disagree ■ disagree ■ neither agree nor disagree ■ agree ■ strongly agree

Fig. 3 Course participants' perceptions on critical issues about technology (TechEd)
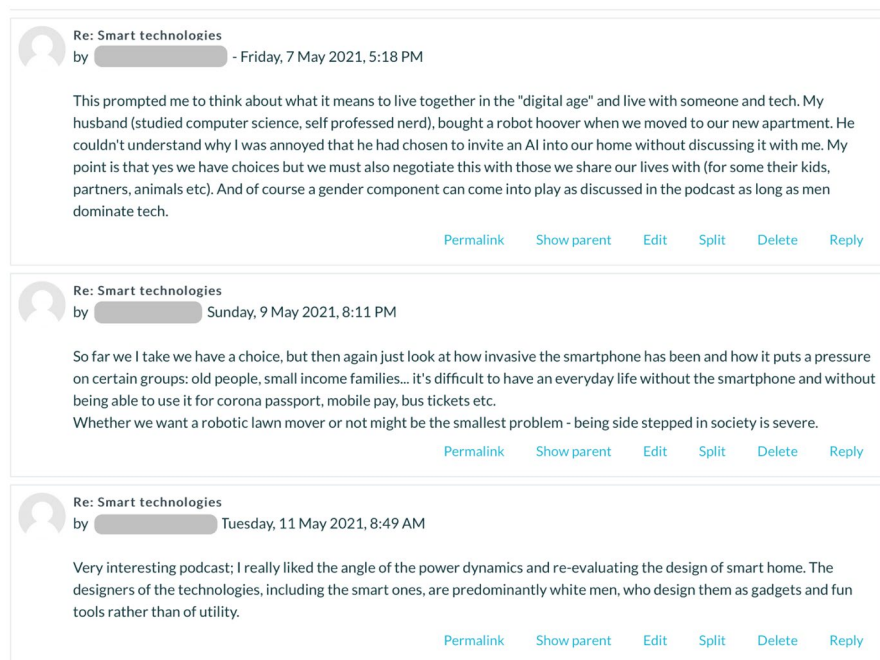
Fig. 4 Forum activity regarding 'Smart technologies' during first trial

taught for, like, more than 20 years, suddenly I find myself having sometimes doubts whether I did a good job today or not! I'd rather know I did not do a good job and then be able to correct it for the next day or refine it or get back on something, than not knowing. They're just sitting totally still and not interrupting each other. (Clara)[1]

Uncertainty was also expressed in examples referring to unclear or blurred boundaries during online teaching and supervision.

I was supervising a student and I could see behind her, like, she was sitting in front of her fridge and it was a baby scan behind her, and I just felt, like, super weird, to have access to this, like, personal information about her, without her thinking of it. (Kirsten)

Given this premise, good teaching in hybrid spaces was interpreted by interviewees as 'what helps' to deal with the restrictions imposed by online teaching formats. The course participants chose the keywords in Table 3 to describe these characteristics:

The *feedback/communication* aspect was mentioned by five out of seven participants, sometimes in relation to the need for reformulating teaching in online formats, sometimes giving focus to increased feedback that is needed from students.

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[1] Participants' names have been replaced by aliases to preserve anonymity.

Table 3 Keywords describing good teaching in hybrid spaces

Course participants		Keywords describing good teaching in hybrid spaces
1	Agnes	Flexibility, vulnerability, communication
2	Kirsten	Boundaries, backgrounds, brevity
3	Clara	Alignment, dynamic, feedback
4	Luna	Diverse methods, planning, facilitation
5	Anders	Efficiency, new ways of planning, clear structure
6	Karl	More interventions, more communication, not working harder
7	Mette	Variation, engagement, humour

(…) you have to be very wordy and facilitate everything that you lack of. All the other senses with communicating work, which for me […] was very overwhelming, because I wouldn't usually say or ask all these questions, but I had to make sure that every – everybody was OK and that it works. I think the whole idea changes when you go into formats like these, it changes the teacher's role quite a bit. (Luna)

I found that I need more interventions, just, like, more segments. My teaching needs to be segmented more, in order to keep people engaged. (Karl)
At the very beginning, I talk vulnerably and openly with the students to 'adjust', you know? Of course, you can't redesign the entire course, but choose activities that work for them. (Agnes)

Another recurrent element that was reported by the interviewees was the need to *diversify teaching methods*. This was in line with the awareness that online teaching needed a completely new format in order to be engaging and meaningful.

The development of diverse methods that fit into this format (online teaching) was something that had to be done really, really quickly. And I think it's the only way to fit into the fact that we can sit at screens just for a certain amount of time. So, for example, I've been sending packages home to students, so they get some stuff there that they can work with and then I get them into breakout rooms where they play with it. I mean, it has been kind of a whole redesign process for us, to be able to develop diverse methods. (Luna)

Pairing students has helped to make sure that they are having some kind of companionship. (…) They have understood that the fellow students are also there to give them feedback. (Anders)

A third aspect that was stressed is the need for *more planning* and clear structure for online teaching.

The hybrid space is kind of making it very efficient, but also forcing colleagues and also the whole institution into new ways of planning. (Anders)

You need to facilitate more, and you cannot just improvise and see what emerges, you have to sort of like…plan it as if you were *in a radio program*. (…) I don't think that all professors necessarily think about preparation as

design, but I think this will become more and more necessary when we go more and more digital – that we need to design a full experience for the students. (Mette)

When asked about teaching competences for (post-)pandemic higher education, the participants mentioned playfulness, creativity and the ability to adjust to better meet students' needs. According to their views, a professional course for teachers in technology education should emphasise discussions and shared ideas and present a focus on processes and activities.

I just found that (in the course) it was really great to see a lot of voices, about how other teachers designed their courses. And it just teaches you to ask questions. (Karl)

There has to be some kind of interaction, if that makes sense. I'm screen-tired! (Luna)

I would really appreciate more guidance on what works and doesn't work. I hope you have that kind of research, like interviews with students and trying to see their perspective. (Kirsten)

I think it should be process-oriented. I think it's very much about how you approach teaching. What kind of activities do you, as a teacher, do? I think that tips-and-tricks might not necessarily work, but certain ideas on different ways and some data is helpful, even though it might not be applicable. (Agnes)

As the above excerpts summarise, the seven teachers who participated in the first Teknosofikum trial especially appreciated the interaction and the chances for discussion that they had with their peers. They were eager for more learning theories and related activities making use of technology. Even though they liked the topics raising critical issues and ethical dilemmas to some extent, they wanted to engage in more discussions about pedagogy and potential activities to translate into their teaching.

Discussion (or Retrospective Analysis)

Design-based research and sociomaterial theories have in common a focus on retrospective analysis, understood not merely as reflection, which according to Haraway (1991) is a displacement of one's own views towards a research object, but rather as a method that seeks engagement with the world (Latour 1987). This method involves 'tracking and tracing' (Austrin and Farnsworth 2005) to unfold the complexity of the researched assemblage.

Following the first trial with course participants, a retrospective analysis of Teknosofikum shows some key findings that need to be acknowledged for future phases of the project. For the sake of clarity in our analysis, we will untangle them according to the categories previously defined in our theoretical framework: hybridity, practice, and ontology.

Hybridity as Responsiveness

The sociomaterial notion of learning space as hybrid assemblage appeared at several points, both in the participants' online contributions to forums and wikis and during the interviews. New teaching–learning assemblages and undefined boundaries between private and professional spacetimes in relation to the pandemic university were mentioned as concrete challenges to good teaching practice. In the hybrid university work settings, teachers experience the absence of voices and faces in the digital environment, the lack of human contact and the impossibility of communicating through bodily expressions. Digital tools and platforms partially replace the usual teaching setting, but the encounter with students follows a different spacetime that redefines teaching completely. Such experiences triggered radical uncertainty and a general feeling of insecurity among the teachers, who found a partial solution in an attitude of humanity, affectivity and care towards their students. A focus on the student group as a community emerged in forums and interviews, and the teachers often underlined their attempts at giving students constant feedback. We summarise these elements under the concept of responsiveness. Rather than simply directing students in the activities, the teachers attuned themselves to emergent needs and dedicated time to responding to these needs in the best way they could find. Not only did this attitude have a positive impact on learning in hybrid spaces, but it also served as a remedy for the teachers' uncertainty. Thus, on our interpretation, responsiveness is a relevant matter for the (post-)pandemic university, not only to cope with teaching but also as an element that improves peer exchange and connection, forming a sense of community in the face of complexity.

Practice as Difference

Planning and imagination skills were stressed as the skills that will be needed most by HE teachers in hybrid universities. In this context, Teknosofikum can be seen as a place where ideas and pedagogical insights can be exchanged productively. To a certain extent, the critical topics about technology and society proposed in the prototype generated curiosity and interest among course participants. However, it was stressed that there was a relative lack of time to explore them in depth, as an academic research approach would require. This caused frustration related to the impossibility of discussing these topics further and left the participants with the general impression that these topics are less relevant to their teaching. Mostly, the participants asked for more content about learning theories and pedagogical anchoring so they could grasp not only the variety but also the difference that distinguishes teaching perspectives and pedagogy from other disciplinary fields. Practice is given value because is situated in and entangled with the world, and a greater variety of practices will lead to more ideas for teaching in the university of the future. Differences among teaching proposals and styles are seen as a source of inspiration. This result points again to teachers' desire to connect with peers across fields by sharing their common experience through reflections that might trigger transformation in their practice.

Ontology as a Process

Finally, a need for process-oriented professional development emerged from the data collected. The course participants were clear about not wishing to acquire more 'digital competences' or 'technical skills' for the use of technology in their teaching practice. Instead, their expectations of professional development pointed in a different direction: establishing reflective tools of one's own that allow for imagination in future teaching. If we analyse these results with a focus on the ontological dimension of teaching, we see that teachers' being and becoming is a process of both continuity and change (Dall'Alba 2009). Teachers are always learning from their practice, their trial and error and their exchanges with peers in a constant process of professionalisation. Thus, acting as teachers responds to being and becoming. The most challenging aspect of Teknosofikum is to integrate all these dimensions. In this first trial, the teachers are asking for credit for their reflective capacity and existing practice and for theoretical and practical tools that can support their process of becoming better teachers. In the next phases of the project, we will have to consider what the purpose of professional education is and how we are to (re)define Teknosofikum's goals from skills acquisition to 'skilful practice' (Dall'Alba 2009: 35).

Conclusion

An initial conclusion of this study is that the materiality and sociality (Law and Mol 2001) of the project have changed with the pandemic. Teknosofikum was conceived and approved for funding a few months before the global Covid-19 breakout in March 2020. At the time of this writing in August 2021, the needs and expectations of university teachers have already changed. In light of these changes, if we agree that design-based research is committed not only to the connection of design interventions with existing theory but also to the generation of new theories (Cobb and Gravemeijer 2008), the process will be considered to include a shift towards a stronger focus on Teknosofikum as a hybrid learning space. This entails considering teacher professional development as more than a mechanism to surface the practice and spaces of teaching in hybrid HE: it is also a sociomaterial space that depends on connections and emerging distributed learning.

Another takeaway of this research is that we need to switch the focus from a static understanding of knowledge to the process of knowing (and becoming through knowing). In fact, Teknosofikum's first course participants proved eager to understand the formations and stabilisations of teaching practices in their respective fields—Law, Design, and Computing—and expressed a desire for further exchange to learn from the differences. However, they showed special interest in 'knowing-in-practice' (Orlikowski 2002) rather than in knowledge as a given object. This finding is also particularly important in order to avoid representational perceptions of knowledge and to reintegrate the body and the environment into the learning processes (Ferrara and Ferrari 2017).

Finally, reflecting on 'being teachers' means focusing more on processes than on methods. Dall'Alba (2005, 2009) stresses that professional development consists in preparing professionals for the challenges of their specific work practice, which cannot be done merely through the acquisition and application of knowledge and skills. Thus, she argues for an ontological turn as a way forward for HE and for a professional education that includes a focus on *becoming* the professional in question. Against this backdrop, teaching in HE is not intended as an identifiable event, but rather as a constantly changing process that depends on institutional cultures, politics of inquiry, history, language, and professional ways of being (Dall'Alba 2009; Fenwick and Landri 2012). Thinking about these matters is a first step to opening a path for multiplicity, diversity and freedom in HE teaching and learning practices in present and future hybrid spaces.

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