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Towards teaching-sensitive technology: a hermeneutic analysis of higher education teaching

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Abstract

Integrating digital technologies to benefit teaching and learning has long been driving higher education. The uptake of technology has been supported by teacher training focused on developing teachers' capabilities to design for learning. However, in this paper, we raise the point of moving towards teaching-sensitive technology as a clear alternative to current strategies focusing on teachers' mental processes. To develop this point, the paper offers a qualitative study that explores teaching to identify critical features of technology supporting teachers' work. Analysing teaching from a hermeneutic perspective, we arrive at six fundamental dynamics within which teachers operate. Based on the factors identified, we present three principles to guide future design of technologies for teaching and two approaches to designing technology sensitive to teachers' values.

Introduction

The urgent imperative to “move forward” and integrate new technology has long been driving higher education. For the last decade, teaching staff worldwide have been encouraged to integrate various digital technologies in teaching and learning environments. Significant resources have been invested in initiatives supporting teachers' technology uptake. These include teacher training programmes and technology-focused units offering technical and pedagogical guidance to teachers (Tømte et al., 2019), situated as the locus of change. A fundamental assumption in such programmes is that because developing productive technology-enhanced learning is far from simple, teachers must become competent learning designers (Conole & Fill, 2005; Dobozy & Cameron, 2018). As highlighted in Lai and Bower (2019), quality technology-enhanced learning requires knowledge of the affordances of technologies and the roles of teachers and students in digital contexts, to mention a few. To integrate these aspects effectively, teachers need to design for learning. Here, learning design typically comprises ‘the process of mapping and/or actually developing specific resources for teaching or learning’ (Kali et al., 2015, p. 174). Goodyear (2005) describes this as ‘educational design’, which he defines as ‘the set of practices involved in constructing representations of how to support learning in particular cases’ (p. 82). While the idea

of designing for learning is widespread, sustainable innovations in teaching are challenged by teachers having limited time to prepare to teach and little expertise in designing and receiving limited acknowledgement of their investments (Kirschner, 2015). Because of this, the argument goes, the best we can do is to allocate more time for preparing teaching and continuously support teachers in using technology and designing for learning.

However, the solid push for better use of technology through fixing aspects of integration makes us overlook a clear alternative. Instead of improving technology integration in higher education by focusing on strategies targeted at teachers' mental processes (designing for learning), why not focus on strategies targeted at influences outside the mind—in this case, technology designs. The argument for making this shift is quite simple: Wouldn't it be better for teachers if their tools for teaching supported their ways of teaching and perspectives on teaching? Wouldn't it be easier for teachers to adopt technology if it was experienced as meaningful and valuable in a specific context? Indeed, this perspective resonates with research on self-control that points to the effect of manipulating outside (situational) factors to hinder an action or 'nip a tempting impulse in the bud' (Duckworth et al., 2016, p. 35). We can also turn to Heidegger's idea of 'useful things,' such as technology. Following Heidegger (2002), useful things should be 'ready-to-hand.' What this means is that their presence contributes to the actions one wants to make in a way that one finds comfortable. Consequently, as An and Oliver emphasize (2021, p. 7), 'the best technology is just like the hammer in Heidegger's hand, which draws no attention to its existence and is easy to use for the work at hand.' Following this logic, the most advanced technology for educational activities will not always be best for supporting higher education teaching and learning.

The paper departs from these provocations. If we want to further technology use in higher education, departing from teachers as the locus of change and conceptions of technology as fully casted makes us overlook technology and how it becomes meaningful for human stakeholders. Following this line of thinking, we suggest studying what teachers *actually* orient towards to better align technology-embodied values with the values of human stakeholders in the future—what Prieto et al. (2024) have described as a key challenge. Thus, the paper offers a qualitative study that explores teaching to identify critical features of technology supporting teachers' work. Ultimately, we ask:

- What are the critical features of teaching that manifest in teachers' descriptions of teaching?

We begin with an outline of approaches to technology for teaching and learning. We then introduce some basic tenets from hermeneutic philosophy to situate our empirical study and apply these hermeneutic insights to the case. By conducting a hermeneutic analysis, we extrapolate from focus group interviews fundamental dynamics within which teachers operate. Finally, we use the extracted features to sketch ways to move forward with technology.

Background

Understanding the role of technology

Technologies for teaching and learning in higher education, including digital instructional tools, learning management systems and tools for the production of digital resources are typically understood as supportive of student participation and learning

and, thus, framed as learning technology or educational technology (An & Oliver, 2021). In this tradition, technological developments play an essential role in realizing the ideals of learning. As An and Oliver (2021) point out, even future directions for education seem to emerge from technological developments.

In this view, the technologies that will be available for students, how and when they are used, are considered to be decisions made by the teachers running the course (Nøhr et al., 2023). From this perspective, which presents technologies as neutral tools in-service to teachers, it is not difficult to understand why technology usage can be understood as manifesting teachers' agency (Langford & Damsa, 2020).

Criticism of this framing is not hard to come by. For example, presenting technology as stable artefacts and in-service to faculty has been criticized for sealing off technology from critical investigations (Bayne, 2015). As An and Oliver (2021, p. 10) also note:

(The) sense of distance from technology is important throughout the history of educational technology; it can be seen, for example, in research into the challenges of technology integration in schools (e.g., Zhao et al., 2002), and explains the feeling that educational technology research is always focused on fixing the integration of emerging technologies, not on understanding the vast array of technologies that are already integral to educational work (e.g., Mayes, 1995).

Although the quote is almost 30 years old, the point is still relevant. Even when technologies have failed to show their potential, they continue to be taken up as organizationally necessary, sustaining a university mission. Hamilton and Friesen (2013) argue that essentialist and instrumentalist approaches presenting technology as an active agent capable of realizing educational goals or absorbing teachers' intentions are a-historical and a-political. Selwyn (2016) says both directions are Ed-Tech speak that position technology as a benevolent force.

Another influential strand of criticism departs from post-phenomenological theory and focuses on 'the relation between human beings and their world' (Verbeek, 2005, p. 108). In particular, the technological mediation of everyday experience (Aagaard, 2017) and the multistability of technology (Rosenberger, 2014) are in focus. The problem identified by this research is that technologies do not exist independently of those using them. Technology is not merely a tool that determines different actions detached from those using it; instead, it becomes a part of those using it.

If there is a heart to the span of critique, it rests on under-theorized accounts of technology and over-simplification of teaching and learning (Biesta, 2012; Biesta et al., 2019), highlighting rational aspects of teaching and denying emotional and human processes (Castañeda & Selwyn, 2018). Notably, the same critique has already expanded into research into AI (Zawacki-Richter et al., 2019). All of these trends work towards a detachment of technology and human ways of being in the world and a denial of the role of human endeavour in using technology.

A hermeneutic perspective

To explore what is meaningful for teachers, we can use hermeneutic phenomenology. As Henriksson and Friesen (2012, p. 1), in the introduction to 'Hermeneutic Phenomenology in Education', put it, phenomenology refers to the study of experience, and

hermeneutic is the 'art and science of interpretation and thus also of meaning'. In this way, hermeneutic phenomenology focuses on both experience and its meanings. Experience, in this case, is to be thought of as something that happens to us and less evidence or knowledge of something (Henriksson & Friesen, 2012). At the same time, meaning is not a universal truth but occurs in a context. Thus, hermeneutic research approaches reject the provision of 'true' views of human experience based on a theoretical framework (Dreyfus, 1980) as it succeeds by decontextualising humans. Rather, man is, Geertz (1993, p. 5) states, 'suspended in webs of significance he himself has spun', where culture is those webs.

We are also reminded by hermeneutic phenomenology that lived experiences are not merely raw data but delimited by a temporal 'horizon' set by past experiences, anticipations, expectations, as well as memories and habits (Brinkmann & Friesen, 2018). According to such thinking, the search of meaning demands interpretation and the intellectual effort of venturing into so-called thick description encompassing 'sorting out structures of signification (...) and determining their social ground and import' (Geertz, 1993, p. 9). In what follows, we seek to probe the phenomenon (teaching) as a lived experience and draw on interview data to offer a thick description of the phenomenon.

Methodology

The material presented in this paper is part of a broader multi-method study on Danish higher education teachers' experiences and the use of digital technologies to support student learning (Løkkegaard & Misfeldt, 2022). The university review board has approved the study. In Denmark, governmental initiatives, framed as top-down processes, have influenced local decisions and strategies (Tømte et al., 2019). The Danish universities have initiated substantial changes to teaching and curriculum over the last decades, particularly relating to digital technologies and the employability of graduates. For example, universities have implemented digital platforms to support course content and information distribution and digital technologies to support teaching and learning activities. Learning analytics has led to university initiatives focusing on finding ways to support student learning and teachers' student learning management.

This study used qualitative focus group interviews to elicit rich, in-depth insights into teachers' experiences. The interviews with academic staff from a primarily campus-based and research-intensive university in Denmark were undertaken in June 2022. The academic teachers were recruited through an open call published in a survey of digital teaching at the university distributed to teaching staff with teaching obligations during the Fall of 2021. Out of 749 academics responding to the survey, approximately 100 teachers agreed to receive an invitation for follow-up interviews. Based on a purposeful sampling strategy (Creswell, 2009) with saturation as the main criterion, we included respondents across all career levels and all faculties at the university. Adding logistics to this puzzle, we ended up with five focus group interviews and a total of 18 academic teaching staff. Four focus group interviews were conducted with the respondents in the same physical room. One focus group interview was conducted online using Zoom. Most focus group participants were men (F: 5, M: 13), resembling the overall distribution of survey respondents. While the respondents represented every faculty at the university, the sample was dominated by the "harder" fields of natural sciences and health,

as were the responses to the survey through which the teachers were invited. Finally, the respondents ticked off the vast span of academic positions from professors and teaching assistants to external associate professors.

The authors conducted the interviews in Danish or English, depending on the composition of the focus group. The interviews were semi-structured and conversational in style, meaning that we followed an interview guide yet allowed for exploring spontaneously occurring topics (Brinkmann, 2018). The initial interview guide concerned educators' perception of the digitalisation of teaching and learning ("How does the digitalisation of teaching and learning come across in your everyday life?") and surveillance ("Do you worry about the tracking and collection of your digital data?" "Why/why not?") but the guide also contained questions about future environments for teaching and learning ("Given the opportunity to make use of a better teaching and learning environment, what would you like to have and include?" and "what would you want to be able to use or have access to in case of a new pandemic?"). Each focus group interview lasted one hour and was transcribed by two research assistants.

Following the interviews, the authors proceeded to read the transcripts. Using the hermeneutic approach, we sought to probe the phenomenon (teaching) as a lived experience and capture nuances of the phenomenon by adopting an abductive approach to make sense of our data. The abductive approach is particularly suitable in 'situations of uncertainty' (Brinkmann, 2014, p. 722). As a form of reasoning, it calls for theoretical sensemaking through questions such as "How is it possible?" and "What must we consider for this instance to make sense?" Accordingly, we used interrogative words (i.e. who, what, why, when, where, how) to make sense of our reading, with each word representing a factor. This approach aligns with the hermeneutic phenomenological approach of examining four lifeworld existentials: (1) body, (2) time, (3) space and (4) relations with others (Veletsianos & Miller, 2008). Importantly, we do not aim to provide extensive accounts of each factor in this study but to offer examples demonstrating the contextualised and professionalised nature of the phenomenon. Therefore, the quotations that we use are those that best illustrate the points of interest. Danish dialogues have been translated into English. All names are pseudonyms.

Findings

Establishing desirable teaching environments

By far, the educators imagine better opportunities for interaction when asked to picture future desirable environments for teaching and learning. This example serves as an illustration:

Peter: I focus on interaction. Because I am a language teacher, I may have different ways of lecturing and teaching. Language learning requires interaction. I can easily have 40 students in an interactive class. I did it in the autumn in one of the big auditoriums. It still worked out well. Large groups of students are not an issue, per se. However, hybrid teaching is a significant issue. In particular, the hybrid teaching that we conducted during the pandemic. Whilst doing so allowed us to include people not permitted to come to class, teaching is much better when no one is sitting out there, just looking.

Another quotation:

Carl: I need dialogue continuously, and I want to see that “you look like one on the verge of raising a hand. What are your thoughts?” When they are less active, I need to be able to respond immediately: “Take five to discuss with peers” and listen to the noise in the room. Is the discussion flowing? When more and more students stop talking, I take over. My teaching is better when I can pick up on such cues.

The quotation clarifies that desirable interaction depends on co-presence, vivid ways of being together and access to social cues. Additionally, some teachers refer to Rosa (2017) and his conceptualisation of resonance involving a dual movement of being touched and giving a response, thereby establishing a connection to frame what they seek. In particular, resonance stresses the vital role of relations contrasting the priority given to individual autonomy in education (Felski, 2020). The previous examples equally illustrate this point.

However, it should also be noted, as Sophie explains, that desirable futures rest on the premises of functional physical facilities:

Author: Given the opportunity to use a better teaching and learning environment, what would you like to have or include?

Sophie: This may be a bit off-topic...

Author: Please share it anyway

Sophie: The physical facilities. The auditorium is old-fashioned and worn out. There is hardly any oxygen—I mean—lousy ventilation. People get a headache due to a lack of oxygen

Julie: Bad chairs too

Sophie: It is challenging to facilitate group work. People cannot sit down to talk with their peers during a lecture. The light does not work. There is no one systematically checking if the light works or not. Everything creaks and creaks. The chairs are falling apart. The physical facilities really need an upgrade

We can conclude *that coveted teaching comprises human co-presence, relationships, interaction, and physical facilities that facilitate dialogue*. As teaching in Danish universities is mostly a campus-based practice, ensuring that the rooms for teaching are practical and conducive to human interaction is critical. In what follows, we will go through six factors determining preferable forms of teaching.

Factor #1: who (relation)

The first factor determines who is involved in the educational space and their relationship.

Thomas: To me, it is about living in a time when courage is needed to teach. In particular, to deal with sensitive topics. We need to be courageous to do so and be in a sensitive space. For me, being courageous requires social contact and contract—and them knowing that I am friendly and will treat them respectfully. I would be reluctant to do so without social connection.

Author: Yes.

Thomas: Speaking of sensitive topics, we can benefit from using technology. However, the old ways are helpful when asked to do more than this, something more blended.

Carl: Yes, and it depends on what it is about. I actually developed a good relationship with my master students, even though we never met. However, we were very close and

very confidential. Also, not having a fixed curriculum played a role. Dialogues should be respectful, and you need to treat others' presentations respectfully.

As visible in the excerpt, the interactants in environments for teaching and learning comprise teachers and students. Their roles are distinct as well as entangled. While teachers teach and facilitate learning and students learn and participate in learning activities, teachers are affected by students' doings and vice versa. Ashwin (2012) tries to develop this entanglement further in his book 'Analysing Teaching–Learning Interactions in Higher Education', arguing that teaching and learning are different aspects of the same process comprising teachers and students engaging together. Additionally, teachers and students are not only cognitively involved but emotionally involved, which research into relational agency has given a clear indication of (e.g., Burkitt, 2018).

More so, students and teachers are only temporarily involved, contrasting the relationship with research colleagues of a longer commitment. As expressed by Hanne in one of the interviews:

Hanne: We met with our colleagues, whom we regularly meet physically and online. Although we were in different parts of the world, we could work on some tasks, such as planning.

We conclude that teaching involves teachers and students embedded in a temporary, complex, dynamic relationship. Principles of professional and relational care underpin the relationship.

Factor #2: what (content)

The second factor determines the teaching content: What is the object of teaching? In this study, in which the teachers were asked to comment on the environment for teaching and learning, the quotations that illustrated aspects of content were less subject-specific and more focused on what teachers deliver.

Finn: Sometimes, a hotshot will be around "preaching to the people", which is fine, but students might as well be online.

Author: Because it is one-way communication.

Finn: Exactly. In such circumstances, you might as well record the lecture, and you will have access to it forever. I understand why students stay at home if this is how teaching is approached. Teaching needs to include something else. Teaching also needs flexibility, allowing students to sit and look at the teacher but also turn around and talk to peers. In addition, teachers should be able to walk around in the room and such.

If teaching merely presents knowledge to students, as hotshots in the field tend to do, according to Finn, it is generally perceived as a simple version of teaching. Instead, the content of teaching extends beyond the knowledge presented to students. In Finn's words, the object of teaching is student learning through interaction with peers and the teacher. In these cases, it is helpful to have access to better environments for teaching and learning. The difference in approaches to teaching framed by Finn resembles the qualitatively different ways of approaching teaching found in the Approaches to Teaching and Learning research (Prosser & Trigwell, 1999) between teacher-focused and student-focused approaches. We conclude that *teaching revolves around student learning as a process facilitated by dialogue and access to subject-specific content.*

Factor #3: why (purpose)

The third factor determines why the teaching is seen as practical or purposeful. Why does teaching have a purpose?

Hans: Thinking in new ways and being creative—does not get me anywhere.

Bo: Besides personal satisfaction.

Hans: Personal.

Simon: Personal satisfaction is the reason why I do what I do. However, I have been warned against becoming a good teacher as I might be asked to do more.

Bo: Sure. People who mess around with teaching without taking it seriously are better off in academia.

Author: In what ways does it become a personal satisfaction? What is it that you are seeking that offers personal satisfaction?

Bo: It is the light in students' eyes. When they get it." Now I understand it much better".

Simon: Yes, exactly.

Hans: And when they approach you after class or ask a question, you sense the energy flowing from them. When they have suddenly become engaged. The feeling of having ignited a spark.

Students' deep engagement and appreciation for what the teacher is doing are generally perceived to be the personal purpose for teaching—besides having to teach as part of one's job description. As one of the teachers said: 'There is no funding involved, but it offers personal satisfaction.' This makes teaching seem like a combination of an unselfish activity aiming to develop students as academics and a self-centred activity that makes teachers feel better about themselves. Here, teaching becomes something you do because the interaction between the teacher and the students offers personal satisfaction. Importantly, teaching should involve interaction with students and, as Bo and Hans state, quickly detectable bodily and verbal signs of deep engagement and interest by students, such as approaching the teacher, asking a question, or making eye contact. As indicated by this, *teaching is driven by personal satisfaction, nurtured by a panoply of observable and easily accessible signs of student engagement.*

Factor #4: when (timing)

The fourth factor that determines preferable teaching is timing. When is teaching practical, and for how long?

Hanne: Being able to sense what is happening in the classroom offers you a lot of energy. Being able to pick up on topics they are discussing—saying," Let us spend some time on this".

Author: Yes.

Hanne: or following up on a discussion with a student during one of the breaks, which is vital to all students. When you deviate from what is planned.

As illustrated in this example, the timing of teaching is location-bound. In this case, it occurs when teachers are present with students in a lecture room. While it appears distinct from the planning of teaching or subsequent teaching obligations, such as written feedback on assignments, it does not exclude breaks during lectures with students nearby. As such, teaching involves situations close in time to in-class teaching and lecturing. Equally, the example illustrates that teaching is a matter of timing, such as being

able to react in time and deviate from the plans when needed. Moreover, spontaneously allocating time and letting go of time to discuss an academic topic appear as signs of care towards students' learning and the academic topic in focus. It reminds us of Adam's (2008) notion of timescapes and, in particular, how teachers' emphasis on timing, tempo, and sequence can be interpreted as attempts to synchronise human interest. The micro-level timing supplements the organizational framing of time, e.g., the date and time for teaching, working towards synchronising human action in education. Thus, *teaching comprises unfolding the organizational-allocated time for interactions with students. The unfolding of allocated time involves both planned and spontaneous use of time as well as slots of time allocated for lectures and breaks in time allocated for unexpected interactions.*

Factor #5: where (location)

The fifth factor determining preferable teaching is the location. Where is the scenario valid? Which other locations does it involve? As made clear from the excerpts already included, positive forms of teaching are situated in time and space. Typically, the space comprises the university buildings as a geographical location. However, it is not as simple as that. The space also includes the classrooms as the space inhabited by the furniture, air quality, and teaching resources used in the rooms. More so, it involves the technologies expanding the classrooms and the personal space of students attending teaching online. This description shows that teachers' experiences of *where* can be referred to as a 'hybrid learning space' (Ellis & Goodyear, 2016), combining physical and virtual learning spaces for student learning. That said, the hybrid learning space does not qualify as hybrid if we understand hybrid as something other, some kind of new species, form or culture (Nørgård, 2021). Thus, *teaching unfolds in a hybrid space, combining physical and virtual learning and tactile spaces.*

Factor #6: how (realisation)

The final factor is realisation. How is teaching realised, and what stands in the way? Do the educators say anything about that?

Carl: I am nervous. I fear that more will end up being about preparedness because it is easy to measure and assess—in terms of the digitalisation of formal assessment. When faced with choosing between human factors and creativity or saving money, they would choose the latter. This worries me. However, I am not worried about the economy as such. I am concerned about how learning and taxonomies are affected.

Author: Do you see it happening already?

Carl: Absolutely. Universities are under a lot of pressure to squeeze out every drop of the lemon. E.g. how can we make formal assessment cheaper? Learning is not driving higher education. Economy is.

Hanne: I second that.

Lars: Me too.

Paradoxically, the focus group interviews reveal that higher education teachers are already capable and intrinsically motivated to move forward on positive forms of teaching. Yet, they are constrained by external sources of action. These comprise the state of the buildings and classrooms and the lack of acknowledgement of teaching competencies

and contributions to student learning. More so, the logic underpinning universities starkly contrasts the logic of education, according to Carl (informant), and, thus, challenges teaching ideas emphasising interactions and productive environments. The interviews also illustrate that teachers have become accustomed to taking economic realities into account. Indeed, several teachers find it challenging to overstep the boundaries of experience in imagining futures, stating that their solutions are pragmatic because they consider the reality of the university. As this makes apparent, *money issues, university incentives for teaching, past experiences and future expectations constitute and hinder teaching.*

Discussion

Teachers-teaching

As the study demonstrates, coveted teaching comprises human co-presence, relationships, interaction, and physical facilities facilitating dialogue. It is a meaningful activity constituted by a host of contextual factors. It:

- Involves teachers and students embedded in a temporary, complex, dynamic relationship. Principles of professional and relational care underpin the relationship.
- Revolves around student learning as a process facilitated by dialogue and access to subject-specific content.
- Is driven by personal satisfaction, nurtured by a panoply of observable and easily accessible signs of student engagement.
- Comprises the unfolding of the organizational-allocated time for interactions with students. The unfolding of allocated time involves both planned and spontaneous use of time as well as slots of time allocated for lectures and breaks in time allocated for unexpected interactions.
- Unfolds in a hybrid space, combining physical and virtual learning environments and tactile spaces.
- Is constrained by money issues, university incentives for teaching, past experiences and future expectations.

These findings resonate with previous research. Among others, research emphasizing teaching and learning as nested in an ecological educational landscape (Damşa et al., 2019) in which people draw on an ecology of resources—a wider pool of resources and infrastructures to construct their practice. In line with Deci and Ryan (2008), competence, autonomy, and relatedness appear to be essential psychological needs on the teachers' part, and relatedly, pedagogies of care and self-care are imperative tenets of teaching, following research by Marhauskaite et al. (2023).

Interestingly, our findings also stress the importance of fugitive practices, in line with recent research by Gourlay. Gourlay (2023) sees three qualities of fugitive practice (p. 60):

In the context of the university, these might be ways of being, practices, or actions which are not primarily focused on making a connection or an entanglement with other people or entities, or they are, also have another more essential quality. There are several elements which I would argue characterise these examples. One

is ephemerality. Certain of these practices are fugitive by virtue that they are not recorded via notes or digital technologies, but take place in a particular moment, in a fleeting manner. A second characteristic is seclusion. Many of these practices take place in a solitary mode, unobserved. The final characteristic I would suggest in the case of conversation, is that of these foregoing elements plus face-to-face copresence in the same physical space.

Taken together, ephemerality, seclusion, and copresence can be understood as pre-digital practices and are likely to be associated with the past or old-fashioned ways of teaching. Nevertheless, they express qualities valued by teachers. One might suggest, as Gourlay (2022) does, that the characteristics go against the tendency of rendering humans into documents. Additionally, the findings seem to support Ingold's (2011) argument for thinking of connections as meshwork, a tissue of trails, instead of nodes in a networks, and more a way of being in the world instead of 'infusion of spirit into substance' (p. 68).

Aligning technology with human values

An obvious next question is whether the factors identified can be converted into implications for the design of technology. There are at least three answers to this question: Building on the findings presented above, we first distil three principles to guide the design of teaching-sensitive technology. The three principles are not exhaustive. Instead, they may complement other relevant guidelines [e.g., Mitchelle and White (2010) and Brod et al. (2023)].

Principle 1: Technology should support informal and spontaneous synchronous interactions between individuals, groups, and content. With the first principle, we recommend that technologies support synchronous interactions involving specific discourse features and topics beyond course content (Hrastinski, 2008; Hrastinski et al., 2010). This principle suggests focusing on supporting informal and spontaneous interactions occurring between people. Thus, a logic of power based on pre-defined hierarchies will be less conducive to this type of interaction. When working with this principle, technologies should support interactions emerging between individuals and larger groups of people.

Principle 2: Technology should support the exchange of observable signs of affective engagement. With the second principle, we recommend technologies to pay attention to ways of expressing and mediating affective engagement. In particular, signs of affective engagement and the possibility of picking up on these signs appear to cultivate a caring learning environment. When working with this principle, technologies should ensure that affective engagement is easily observable to others. We encourage future use of this principle to explore how to integrate this aspect, taking into account students' and teachers' digital agency (Stenalt, 2021) and legal restrictions to track emotions (European Commission, 2023).

Principle 3: Technology should strive to reduce teachers' cognitive load in interactions. With the third principle, we recommend technologies to support teachers' use of technology as part of teaching unfolding. In this way, it is critical to design for situations of use that are already complex and uncertain, requiring teachers' use of a range of competences and skills. Reducing teachers' cognitive load (Ginns & Leppink, 2019) is, thus, a

pertinent issue. In this manner, we encourage future designs to consider ways to distribute the managerial burden of teachers to, other interactants, such as students.

However, when looking across the factors identified encompassing a mixture of dynamics, what is most striking is perhaps the attention to aspects beyond efficient teaching and cognitive engagement, i.e., teachers' attention to spontaneity, affect and care. These perspectives point towards adopting an aesthetic approach to designing technology. As Petersen et al. (2004) presented, aesthetic interaction emphasizes experiential aspects. It is 'not about conveying meaning and direction through uniform models; it is about triggering imagination, it is thought-provoking and encourages people to think differently about the encountered interactive systems, what they do and how they might be used differently to serve differentiated goals' (Petersen et al., 2004, p. 271). According to the perspective offered by Petersen et al. (2004), aesthetic interaction treats interactants as improvisators, the appropriation of technology as playful, and the ideal for interactions to be stimulation and curiosity, rather than efficiency. If experiential aspects are essential, as our findings suggest, aesthetic interaction appears to hold some potential. At the very least, it can be used as a provocation to existing technologies and the interaction paradigms adopted.

Finally, proposing that technology is situated and contextualized, our findings also point to the importance of adopting value-sensitive designs of technology, which is 'a theoretically grounded approach to the design of technology that accounts for human values in a principled and systematic manner throughout the design process' (Friedman et al., 2017, p. 1). Among others, it commits to identifying the direct and indirect stakeholders in a project, taking into account human values, defined as 'what is important to people in their lives, with a focus on ethics and morality' (Friedman et al., 2017, p. 6), and adopt iterative design methodologies such as value-oriented semi-structured interviews and value-oriented mock-up, prototype, or field deployment (Friedman et al., 2017). By adopting value-sensitive methods, ethics might become a source of design rather than just a constraint (Van den Hoven et al., 2012). While rarely used for designing educational technology (Gerdes & Frandsen, 2023), the integration of values and moral considerations, such as privacy issues, has been identified as a means to counter ethical challenges and leverage the adoption of technologies in other fields.

Limitations

The novelty of this paper lies in the study of teaching from a hermeneutic perspective, which allows us to identify qualities that can be presented as requirements for developing and selecting technology. More specifically, our study empirically identifies human stakeholders' values that technology should align with. However, to what extent are our findings generalizable? There are at least two answers to the question. A hermeneutic interpretation is not the type of interpretation that claims universal validity (Iser, 2000). That being said, the factors through which we explore teaching are arguably universal and applicable to other explorations of teaching in various contexts. This would allow others to emerge in similar research to identify teaching qualities. Of course, what is essential is the importance of these factors for technology development. For instance, do the factors identified apply to all teachers? The best answer is: Probably not. Stating that contextual factors will have the same effect across contexts forgoes our previous

experiences with integrating technology globally and contradicts the theoretical perspective adopted in this study —the contextualized nature of technology matters. With this in mind, exploring how key features of teaching vary across contexts such as disciplines and country and personal characteristics such as gender and career level is worth pursuing and not addressed by this study.

Concerning validity, van Manen (2016) describes a good phenomenological description as one that evokes *a nod of recognition* from the reader. In this case, the focus group interviews allowed us to identify and extract data that tapped into shared realms of experience (Henriksson & Friesen, 2012), resulting in nods of recognition within groups or across groups.

Conclusion

Strategies for integrating technology in higher education teaching and learning have typically focused on developing teachers' learning design capabilities. In this paper, we raised the point of manipulating outside factors (technologies) as a clear alternative to current strategies targeted at teachers' mental processes (designing for learning) to improve future higher education. To make this point, we explored teaching *to identify critical features of technology supporting teachers' work*. Using focus group interviews, we arrived at six contextual factors determining teaching. By eliciting these dynamics, we hope to pave the way for designing teaching-sensitive technology, which is valuable for higher education.

Author contributions

Both authors took part in designing the study and collecting and analysing the data. MHS was a major contributor in writing the manuscript. All authors read and approved the final manuscript.

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Nothing to declare.

Availability of data and materials

The data that support the findings of this study are available from the University of Copenhagen, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of University of Copenhagen.

Declarations

Competing interests

The authors declare that they have no competing interests.

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