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'It opened a new teaching space for me': Transforming higher education practice through digital education

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ABSTRACT

In-service teachers' professional development (PD) courses on digital education tend to be based on a restrictive idea of 'knowledge transfer' presupposing an application of course content into practice through a top-down and linear approach. In this paper, we adopt a broader conceptual perspective to examine the learning outcomes of an online/hybrid PD course developed through a design-based research project between 2020 and 2023 and attended by 98 participants from four Higher Education institutions in Denmark. We draw on the cultural-historical activity theory concepts of 'recontextualisation' and 'construction/instantiation' of the object of activity to analyse interviews with course participants ($n = 15$). The main findings reveal how the teachers engaged with the resources they encountered in the course to reshape their teaching practices by personalising these resources and adapting them to situated concerns. We identified three types of resources (knowledge, tools, and networks) that the teachers *recontextualised* to achieve transformation of their practices. This transformation happened in two ways: by reconstructing and remediating problem spaces in teaching, and by bringing about concrete solutions to both existing and newly formulated challenges. In this process, peer feedback and collective discussions were essential elements of the teachers' learning process. In conclusion we discuss the broader relevance of our findings for designing and evaluating online and hybrid digital education PD courses.

1. Introduction

Developing the quality of teaching and teachers' digital competences through pre-service as well as continuing professional development (PD) initiatives has become a global priority for Higher Education institutions (HEIs) (Bennett et al., 2022). European policymakers have emphasised this need (Inamorato dos Santos et al., 2023) even further since the COVID-19 pandemic (Markauskaite et al., 2023) and with the more recent introduction of generative AI tools in Higher Education (Driessens & Pischetola, 2024). During 'emergency online teaching,' many teachers transferred their traditional practices online without adapting contents and pedagogies to the new context (Littlejohn, 2023) and it became evident that developing digital competences requires a focus on both pedagogical and technological knowledge (Basilotta-Gómez-Pablos et al., 2022). This would allow teachers to know 'when and how to use digital technology' in their teaching (Skantz-Åberg et al., 2022, p.11), and when technology is not necessary (Wichmand et al., 2023). The

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main purpose of PD courses in digital education is, thus, to support teachers to integrate new knowledge in their existing work, with the result of restructuring their current practices.

Despite the importance of this integration as 'the most important piece in digitalisation efforts' (Bennett et al., 2022, p.149), PD courses often fail due to restrictive a priori assumptions about professional learning and top-down approaches that do not account for participants' professional needs or connect with their practices (Postholm, 2012). Moreover, learning designers are often unaware of how teachers learn, develop professional agency and participate in collaborative activities (Korthagen, 2017). Since the pandemic, these challenges have become relevant for online and hybrid courses too, especially given the increase in the number of PD offered online (Meyer et al., 2023) and the improved general attitude towards online course provision (Billett et al., 2023). Without addressing the challenge of supporting participants' concrete transformation of practices, online and hybrid courses risk facing similar issues as their face-to-face counterparts (Billett, 2021) along with additional challenges regarding maintaining learning momentum and engaging across multiple temporalities (Poderi et al., 2024).

To address these weaknesses, in this paper, we adopt a theoretical framework which has *context* as its core concern. We draw on the concepts from the cultural-historical activity theory (CHAT), which understands teachers' learning as a process of changing how they interpret and act in the world (Edwards, 2005) and considers all forms of knowledge contextual and visible through reasoning in practice (Evans & Guile, 2012). Then, we complement the discussion with empirical analysis data from Teknosofikum, an online/hybrid PD course on technology education for HE teachers in Denmark. The guiding questions of our study are:

RQ1: *How do HE teachers perceive the possibility to transform their practices after a PD online/hybrid course in digital education?*

RQ2: How does the process of learning recontextualisation occur in their practices?

2. Framing professional learning as recontextualisastion in practice

To understand how teachers deploy their learning about digital education from ProjectT, and with the intent to give more emphasis on participants' experiences (Havnes & Smeby, 2014), we drew on the concept of 'recontextualisation' (Evans & Guile, 2012). Our intention was to move away from the concept of 'learning transfer' often used in PD programs (Sasson & Miedijensky, 2023), which indirectly assumes that teachers are the 'recipients' of new knowledge (Webster-Wright, 2009) that can be frictionlessly transferred from training courses to work practices (Sfard, 1998). The concept of 'learning transfer' is rooted within behaviourist and cognitivist traditions (Greeno et al., 1993; Tuomi-Gröhn & Engeström, 2003), and as several scholars have pointed out, it shows limitations on at least two levels. First, transfer has been hard to assess and demonstrate empirically (Detterman & Sternberg, 1993; Lehtinen et al., 2014), as teaching practices take time and reflective processes to be transformed (Riedner & Pischetola, 2024). Second, transfer carries the assumption that learning means acquiring discrete 'learning outcomes' (Biggs, 1996; Sfard, 1998) which are closely aligned to the intended learning outcomes (ILOs) of the PD course. This expected linearity ends up acting as a stumbling block for assessment and evaluations of PD courses (Saroyan & Trigwell, 2015), even questioning their validity.

These limitations have driven researchers to search for alternative frameworks for the design of PD courses, adopting for example a situated cognition perspective (Greeno et al., 1993; Lave & Wenger, 1991) according to which learning always involves participation in a socio-cultural context through enculturation in a community. In this perspective, 'transfer' refers to changing participation in changing contexts (Lave, 2008). Other scholars have suggested giving value to the workplace learning experiences of in-service teachers, in order to facilitate learning in a setting that is connected with their work. They thus understand learning transfer as a process of developing concrete ideas that refer to teachers' daily practices (Boud & Hager, 2012; Hager & Hodkinson, 2009). Inspired by previous work, we adopt in this study the CHAT approach, which considers cognitive and contextual elements of practices as mutually intertwined (Edwards, 2005; Stetsenko & Arievitch, 1997). As it will be clarified in the next sections, this theoretical approach will enable us to take into consideration both the individual needs/actions as well as the possible deployment of specific activities in specific institutional settings, rather than consider learning as a finite output that can be simply transferred from one context to another.

2.1. Professional learning as changing interpretations and possibilities to act in context

Cultural-historical activity theory (CHAT) is one of the theories arising from the seminal work of Vygotsky (1978, 1986) and Leontiev (1978) on how individuals learn by engaging with socio-cultural practices. It differs from other lines of cultural-historical theory, in that it focuses on collective social practices, such as those referring to workplaces (Wilson, 2014). Therefore, CHAT can be used both as a theoretical tool and as a methodological framework to analyse human interactions and relationships within social contexts (Popov, 2019. Within CHAT, professional learning and development of teachers are seen as processes of re-mediation in which professionals are changing how they interpret and act in the world. Here, learning outcomes refer to an ongoing process of developing expertise through 'changing one's interpretation of contexts and possibilities for action within them' (Edwards, 2000 p. 200). This aligns with studies showing that rather than unproblematically transfer, professionals routinely reshape and transform knowledge for their practice (Evans et al., 2010) , materialising their interpretations into concrete actions (Wichmand et al., 2023). In this view, professionals can '*select, appropriate, and transform knowledge differently depending on their own personal histories and inclinations*' (Hordern, 2014 p.171, italic added). To study this process of transformation and re-purposing of knowledge when exercising professional expertise and agency, we focus on the CHAT-based notion of recontextualisation. This concept assumes that all forms of knowledge are contextual, but not context-bound (Evans & Guile, 2012), meaning by this that knowledge is constantly co-created within the collectivity in a particular context (Wilson, 2014). In this sense, knowledge can be understood as 'cognition in practice' and it is made visible in professional judgement and reasoning (Guile, 2019).

2.2. Recontextualisation

One way in which professionals can change interpretations and possibilities to act in context is through recontextualisation of cultural resources from another context, such as for example a PD course. The concept of recontextualisation was introduced within CHAT as an alternative framework to the cognitive-behavioural approach that posits that learning needs to be 'decontextualised' to successfully apply to new activities (Van Oers, 1998 p.137). Guile expanded the concept (2014; 2019), recognising its generative potential and arguing that recontextualisation can offer researchers a way to think about theory and practice in professions as interrelated rather than distinct modes of activities. One implication of this is that professional expertise can be thought of as a 'capacity to act' by continually drawing on and contextualising different forms of knowledge and resources (Guile & Unwin, 2020).

In his earlier work Guile (2014) identified two types of recontextualisation of relevance to PD: the workplace and the learner recontextualisation. The former refers to the idea that workplace settings and underpinning practices will 'affect how knowledge is put to work and vary in what quality of experience they can afford' (Evans & Guile, 2012 p.119). Learner recontextualisation suggests teachers are actively improving their capability to modify their practices at work by 'commingling' theoretical (e.g. concepts and ideas from a PD course) and practical knowledge. What underlies these two modes of recontextualisation is the object of activity (Leontiev, 1978) and its role in how we 'deploy resources […] to accomplish that activity' (Guile, 2014 p.80). Teaching practice and PD courses have different objects of activity necessitating a range of modifications of prior learning and available cultural resources. To recontextualise extant knowledge is, thus, to exercise an agentive capacity to distance oneself from one's immediate surroundings using cultural tools (Vygotsky, 1997), as well as to be cognisant of 'the possibility to intervene in, and transform the meaning of, situated activities' (Mäkitalo, 2016 p.64).

To further clarify how practice can be transformed through recontextualisation, we complement the above discussion with Nardi's work (2005) related to the object-oriented principle proposed by Leontiev (1978). Nardi and colleagues analysed individual actions in the broader context of institutional practices (Kaptelinin & Nardi, 2012) and introduced a distinction between two object-related processes which, we propose, can be seen as two different directions that the transformation of teaching can take: (i) deploying new resources to *construct* a problem space that will be worked on, and (ii) drawing on resources to *instantiate* actions in an already identified problem space. The former entails activities in institutional practices directed at articulating, deciding, negotiating, and 'figuring out what it [the object of activity] should be' (Nardi, 2005 p.40). In the latter case, the problem space is formulated and stabilised and the direction of people's engagement is (re)directed towards putting the work into creating a concrete outcome.

The distinction between the processes of construction and instantiation of actions in teaching activities as two different moments of transforming practice can be useful when considering *how* teachers deploy and recast their learning from ProjectT in their teaching. In other words, the construction/instantiation of objects sensitise us to whether teachers after the course (i) changed how they interpret practices and possibilities to act in them by recognising, identifying and articulating *new problems and challenges to be worked on* (e.g. identify the need to supplement their teaching with hybrid provision) and/or (ii) deployed and refashioned *new resources* from the course to transform their work *on existing problems* in teaching practice (e.g. learning how to use technological tools to increase student feedback).

3. Materials and methods

The research presented in what follows draws on empirical data collected along the deployment of the PD course in digital education - Teknosofikum, whose design was underpinned by CHAT perspectives. This theoretical/methodological framework informed our view of technology as an actor that powerfully mediates human agents' relationship with the world (Fenwick & Nerland, 2014), a view that has shaped both contents and activities with the participants, as it will be explained in the next section.

3.1. Teknosofikum: learning about digital education in a hybrid/online course

Teknosofikum was a design-based research project in Denmark, which was developed between 2020 and 2023 and aimed at creating a PD course focusing on digital competencies of higher education (HE) teachers from different disciplinary fields. The project was funded by the Ministry of Higher Education and Science and developed by a consortium of four HE institutions, a team of five educational designers and researchers. The premise of the course was that trends such as open and generative AI, machine learning, educational technologies tools, and data tracking, call for a new mindset, where technologies are considered not only as additional tools to the existing educational settings, but as active actors in different professions and disciplines (Pischetola et al., 2023). Through this lens, digital competence was defined as 'the capacity to develop agency towards professional changes driven by technology', comprising 'the teachers' ability to evaluate why, when, how, and with what effect to include digital technology in teaching' (Pischetola & Møller, 2023). The development of that capacity was made explicit through seven Intended Learning Outcomes (ILOs) of the course:

(1) Expand knowledge of the implications of technology in higher education.
(2) Expand knowledge about teaching strategies and their connection to theories.
(3) Reflect critically on professional changes driven by technology and innovations.
(4) Reflect critically on the relationship between technology and pedagogy.
(5) Increase capability to use educational technologies autonomously and creatively.
(6) Design teaching plans with new technologies, strategies, and platforms.

(7) Develop interdisciplinary and cross-institutional peer communication.

This list of ILOs was an initial requirement of the institution that took the lead of Teknosofikum, as it is common practice to define intended outcomes in all courses provided to the students and plan teaching accordingly (Biggs, 1996). However, the long and iterative process of the ILOs definition made it clear to the educational designers of the project that there was a need to seek for other conceptualisations of outcomes (i.e. the unintended or actual outcomes) that would not rely on a theory of transfer. The shift towards thinking about ILOs as needing to be recontextualised in practice occurred during the first evaluation stage (in May 2021). In this process of ILOs redefinition, the educational designers embraced a concept of learning outcome informed by CHAT and in dialogue with the participants, enabling considerations for context and recontextualisation to become core (Pischetola & Møller, 2023).

The course had two formats, hybrid and online, both including synchronous and asynchronous activities, to be completed over a span of eight weeks (see Table 1). The synchronous meetings ensured the common knowledge base that aligns with the learning outcomes above. The first synchronous meeting (Workshop 1) took place at the beginning of the course and lasted 2.5 h for online and 6 h for the face-to-face group. In the workshop, the topics of teaching perspectives and object implosions were covered, along with the introduction of educational technologies to promote group work (see Table 1). Subsequently, the participants were asked to complete six out of the total of twelve learning units in the first four weeks of the programme. Given the variety of disciplinary backgrounds and years of experience in the course, there was a free choice of learning units. The participants were asked to complement their knowledge with the units they felt they were least familiar with. The available list of learning units is presented in Table 2. The learning units were organised in two large sections 'technology' and 'education' section, the former can be seen in Fig. 1. After four weeks the participants met again for an online check-in meeting lasting one and a half hours. During this meeting they discussed the learning units they had completed and made suggestions on which learning units might be interesting and relevant to their colleagues. They also identified their technology related learning and teaching challenges they wished to improve on after the course ('the teaching experiment'). After this meeting, the participants had to complete the remaining number of units (e.g. six units). In the final synchronous meeting (Workshop 2) in the eight week, the participants were introduced to different technology perspectives, and collaboratively developed their individual teaching experiments based on their learning in the course, and discussed how to take these techniques and solutions forward in their teaching.

The course design was informed by the ideas that PD courses need to support HE teachers to develop agency towards educational and societal changes (Pischetola & Møller, 2023), and the idea of digital competence as a capacity to develop agency towards professional changes driven by technology (ibid.). To facilitate professional agency, the course provided the participants with great flexibility in terms of format and choice of contents, and focus (technological, pedagogical, or a mixture of the two areas, see Fig. 1).

Furthermore, the participants were offered multiple opportunities for hybrid learning (Nørgård, 2021) through collaborative spaces and activities including group discussions (about challenges, problems, and dilemmas in teaching), mutual feedback on materials (the participants need to realise a teaching plan and present it to each other), as well as conversations in online forums offering opportunities for digital peer learning (Sannino et al., 2021). The synchronous meetings were coordinated by facilitators during on-site workshops and online meetings (see Fig. 2).

The online learning platform displayed a menu of 42 topics (Table 2.) in the form of original videos recorded with experts in the field and podcasts curated from the Web, which were conceived as a simultaneous engagement with theory and practice through theoretical and practical discussions, exercises and assignments that offered insights for reflection on concrete learning situations and teaching activities.

The second important design principle described as 'praxis' (Pischetola & Møller, 2023) proved to be particularly important for the idea of PD as practice-based and as entailing recontextualisation where the theory is always linked to the contextualised meanings that the participants give to it. This principle subsequently aligned well with the idea that ILOs are deployed as resources to be transformed and personalised rather than transferred (Hager & Hodkinson, 2009).

3.2. Research design

The evaluation of Teknosofikum using questionnaires at the end of the course suggested an overall positive learning experience. However, it was unclear why this was the case or what the participants appreciated the most about their learning. The research questions of this qualitative study emerged from the discussion among the educational designers around the need to change the focus from evaluating ILOs to evaluating *actual* learning outcomes or *what participants in* Teknosofikum *found valuable in the course for their teaching practice.*

Table 1
Online and hybrid formats of Teknosofikum with workload.

Format	Asynchronous	Synchronous	Workload	Duration
Online	12 learning units to complete (cc.22 h) on the learning platform by freely choosing from the menu (see Table 2)	2 × 2.5 h meetings (online) in week 1 and week 8 1 × 1.5 h meeting (online) in week 4	28 h	8 weeks
Hybrid	12 learning units to complete (cc.22 h) on the learning platform by freely choosing from the menu (see Table 2)	2 × 6 h (face-to-face) in week 1 and week 8 1 × 1.5 h meeting (online) in week 4	36 h	8 weeks

Table 2
Topics groups on the Teknosofikum learning platform, topics in bold are covered in the workshops.

Technology	Education
Digital Empowerment	Teaching Styles
- Technological attentionally	- Learning strategies
- **Technology implosion**	- **Teaching perspectives**
- Tech and Society	- Feedback and assessment
- Diversity	- Flower model
- Critically literacy in computing	
Digital Trends	Edtech tools
- Biases in Algorithms	- **For online discussion**
- Big data and modern AI	- For online group activities
- Machine learning	- For assignment development
- Applied AI and machine learning	- For flipped content delivery
- Blockchain	
Digital Design	Edtech in HE
- Human and Planet design	- Future of digital education
- Human-tech relations	- Design and ethics
- Smart home	- Online teaching
- Creative coding with AI	- Ideas from teachers and students
- Blended worlds	
Digital tech and regulation	AI and Education
- Law and technology	- Generative AI
- Regulation	- Problematic Edtech
- Regulation by technology	- Education and robotics
- Regulation, organisation and IT	- Education and surveillance
	- Learning analytics
	- Educational potential of AI
	- Automation of education

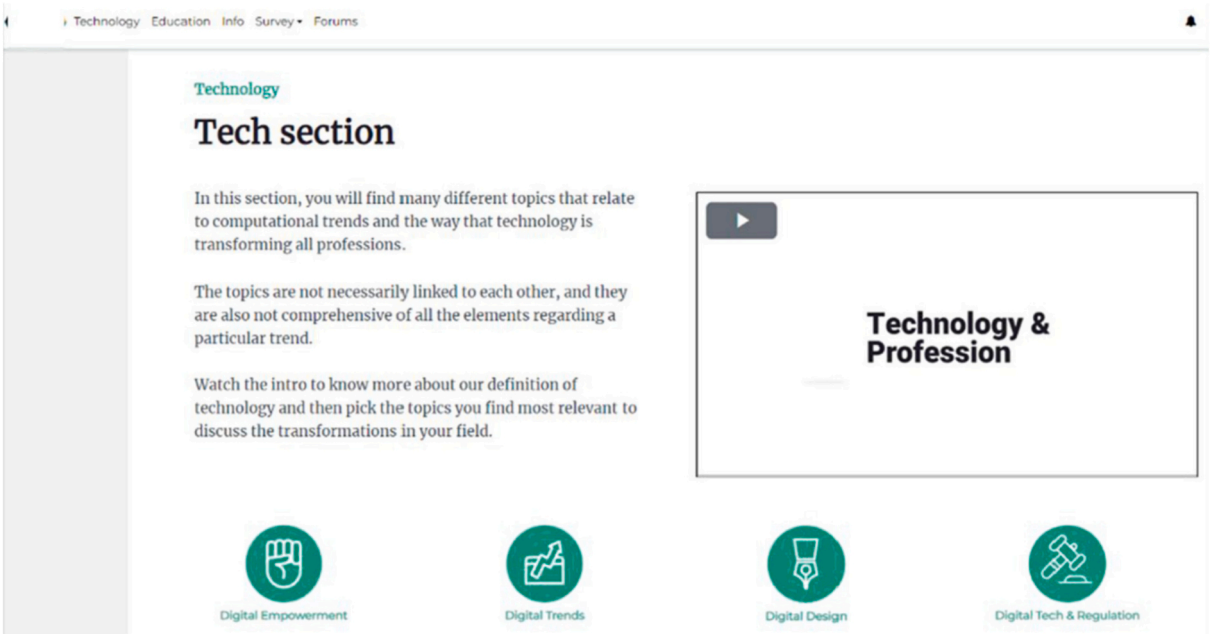

Fig. 1. Teknosofikum online learning platform, technology section.

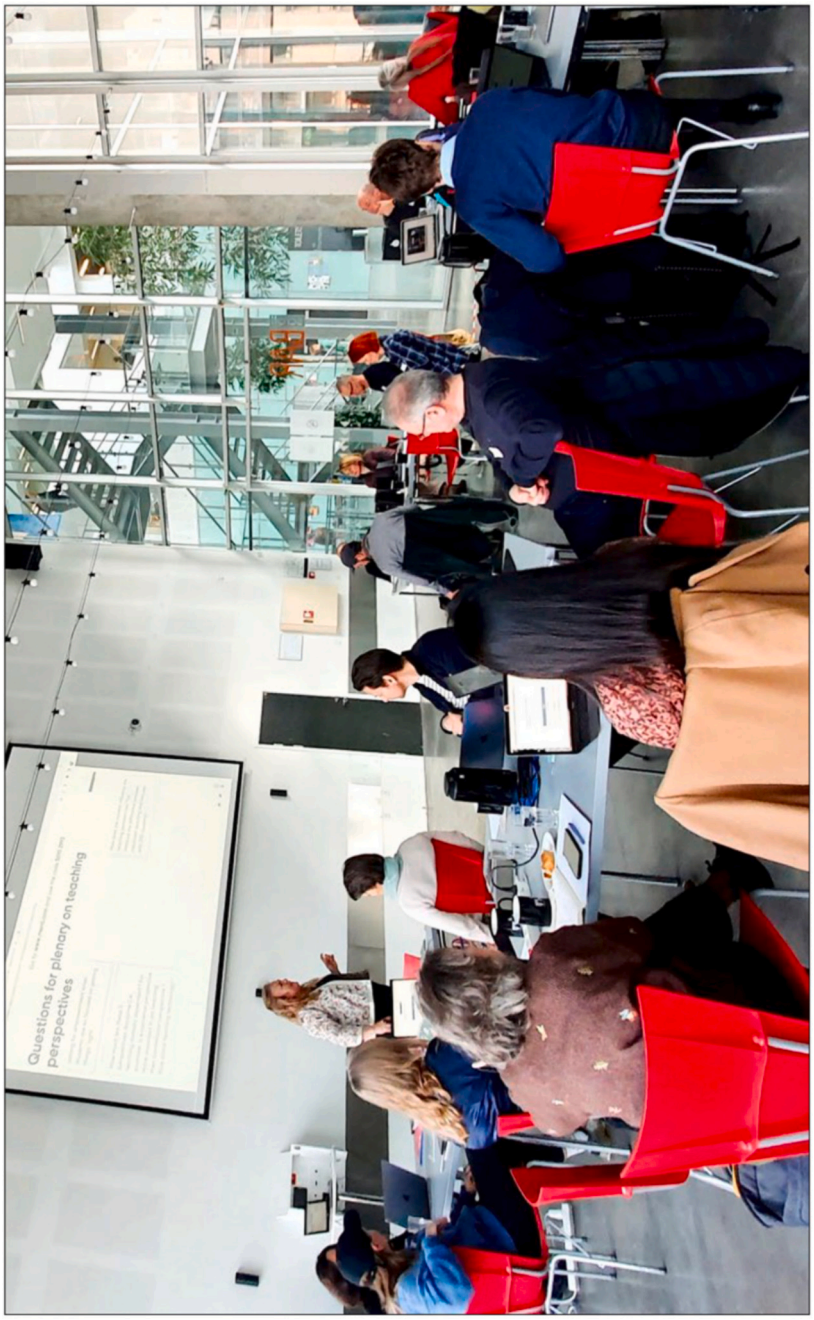

Fig. 2. Teknosofikum opening workshop in hybrid format (Spring '22).

3.2.1. Data collection

Data was collected from semi-structured interviews with course participants during the Spring/Summer of 2023. We invited all course participants who completed the course (98 participants from five different HEIs) for a follow-up interview and fifteen ($n = 15$) agreed to participate. A consent form was sent to participants prior to the interview. The interviews lasted 40 min either online or face-to-face, depending on the interviewees' preferences, and were audio recorded and transcribed. The interviews were part of a broader research focus on the final evaluation of Teknosofikum's course design, learning environment and impact on the pedagogical activities of HE teachers. The interview protocol included questions regarding: participants reflections on PD courses for HE teachers in general, participants' main take-aways from the course, positive and negative aspects of the course they remembered including if they considered dropping out of the course, whether there were changes and transformations in their teaching as a result of their participation in the course, whether there were changes and transformations in how they understand the role of technology in teaching as a result of their participation in the course.

An overview of the interviewees' profile is presented in Table 3 below. The participant pool was diverse in terms of disciplinary fields, academic positions, gender and length of professional experience. The majority (10) of them attended the course in a hybrid format, while one-third attended the online course. We believe that the heterogeneity of the interviewees reflects the diversity of participants in ProjectT and provides a valuable empirical basis for examining different conceptualisations of learning outcomes.

Following standards for conducting ethical research, all interviewees received a research information sheet and an informed consent form informing them about how the interview would be conducted, how their data would be treated, their anonymity ensured, and how they could withdraw consent at any time.

3.2.2. Data analysis

Adopting an inter-rater reliability method in two phases (Cole, 2024) and conducted using Nvivo 15 software, the qualitative data analysis combined inductive and deductive approaches: first-level and second-level coding (De Wet & Erasmus, 2005), illustrated in Tables 4 and 5 for both coders.

In this first phase, the first two authors independently highlighted repetitive themes that could be considered important takeaways from the course (Table 4.). They compared codes, and reached consensus on three categories: (i) ideas, knowledge, principles, (ii) pedagogical and technological tools and (iii) networks. To ensure inter-rater reliability and rigour (Bowen, 2009), the third author audited the coding process, and a final iteration was done in team-based coding (Cole, 2024), presented in Table 5 (see also Fig. 3 in annex).

In the second phase, the authors used thematic deductive coding (Cole, 2024) applying the CHAT theoretical lens to analyse *how* the participants drew on the learning in Teknosofikum to examine their teaching practices and *why* they decided to select and engage with the particular resources in a particular kind of way within their teaching context (Table 6).

4. Results

By combining the codes that emerged from the first phase (Table 5) with the theory-driven codes that we found in the second phase, we arrived at the results in Table 6. The participants conceptualised the transformation of their teaching practice along two dimensions: (i) *what* they took away from the course, defining different types of *resources* that constitute the *content* of recontextualisation, and (ii) why and how they did/would employ these resources in their practice, revealing their construction/instantiation aims. We consider that the first category of results responds more directly to RQ1 - How do HE teachers perceive the possibility to transform their practices after a PD course in digital technology education? - while the second category of results responds to our RQ2 - How does the process of learning recontextualisation occur in their practices? However, as in a process of recontextualisation it is difficult to divide the 'what' from the 'why', the two dimensions are deeply intertwined and overlapping. Therefore, we will present in this section three sub-categories of results that speak of both dimensions, 'what' and 'why', and we will go back to the guiding research questions in

Table 3
Research participants.

ID	Position	Gender	Department	Teach. Exp.	Course format
P1	PhD	M	Architecture and Design	0–5	Hybrid
P2	PhD	M	Digital Design	0–5	Hybrid
P3	Assistant prof.	F	Computer Science	11–15	Hybrid
P4	Assistant prof.	F	Computer Science	6–10	Hybrid
P5	Assistant prof.	F	Architecture and Design	6–10	Online
P6	Assistant prof.	M	Digital Design	6–10	Hybrid
P7	Associate prof.	F	Digital Design	11–15	Hybrid
P8	Associate prof.	M	Nursing and education	15–20	Online
P9	Associate prof.	M	Nursing and education	6–10	Hybrid
P10	Associate prof.	M	Law	11–15	Hybrid
P11	Associate prof.	M	Architecture and Design	11–15	Hybrid
P12	Ext/Temp Lect.	M	Computer Science	11–15	Online
P13	Ext/Temp Lect.	M	Computer Science	0–5	Hybrid
P14	Full prof.	F	Nursing and education	20	Online
P15	Full prof.	M	Nursing and education	15–20	Online

Table 4
First-level inductive coding referring to 'outcomes' of the course perceived by the participants.

Coder 1	Coder 2
1.a Knowledge Gains: Participants reported gaining new concepts and ideas about teaching and technology (18 mentions, 9 interviewees). 1.b New Practices: Participants used Teknosofikum resources to make strategic changes to their courses (14 mentions, 7 interviewees). 1.c New Tools: Participants employed distinct tools from Teknosofikum in their classes (10 mentions, 7 interviewees). 1.d New Networks: Participants used connections from the course for further learning and experimentation (7 mentions, 5 interviewees).	2.a Personal Pedagogical Profile Developments: Participants improved their understanding, knowledge, attitude, and awareness about teaching (10 mentions, all 15 interviewees). 2.b Inspirations and Support for Institutional Developments: Participants gained tools and approaches to enhance student motivation and interaction in class (7 mentions, 7 interviewees). 2.c Tools and Approaches for In-Class Developments: Participants applied lessons from Teknosofikum to broader pedagogical developments at the program, departmental, or institutional levels (4 mentions, 4 interviewees).

Table 5
Second-level coding referring to the deductive analysis.

Themes	*Description*	*First level coding*
Ideas, knowledge, principles	Activities in teaching practices were restructured by using knowledge, ideas, principles form Teknosofikum course. Refers to (a) concrete changes made to teaching practice on the level of course, programme, department, and (b) development of new perspectives on existing issues and challenges in teaching that might be realised in the future	1a, 1b, 2b, 2a, 2c
Pedagogical and technological tools	Conceptual and digital tools introduced in the course were used to address a particular teaching problem	1c, 2b
Employing Networks	Developing and using networks to support meaningful implementation of prior learning	1d, 2c

Table 6
Teknosofikum course learning outcomes according to participants.

Resources	Recontextualisation		*Valuable outcomes*
	Construction of problem	Instantiation of solution	
Ideas, knowledge, principles (e.g. computational thinking; learning theories, AI trends in higher education)	Challenging established and developing new knowledge Exploring and experimenting with different ideas about how digital technologies are transforming societies, universities and professions, as well as learning, teaching and curriculum.	Re-fashioning the course design Drawing on transformed interpretations to change practices and embedded new ideas and principles at the lesson, module or course design level.	Theme 1: Generating and deploying new understandings
Pedagogical and technological tools (e.g. jigsaw teaching activities and techniques, use of digital tools)	Constructing frames for dilemmas Engaging with methods, techniques, tools to identify teaching dilemmas, such as piloting, experimenting, saving, and storing useful resources for students for future.	Deploying new tools/activities Adjusting tools to meet the needs of specific students and modules. Embedding these tools in the curriculum, to address specific challenges. For example, to record feedback and empower shy students or increase students' participation.	Theme 2: Experimenting and teaching with new tools and strategies
Networks (e.g. course participants, colleagues in the workplace, teaching assistants)	Re-constructing understanding with others. Re-constructing interpretations of what teaching dilemmas are, through discussion and iterative feedback on teaching challenges.	Experimenting and developing new solutions with others Gaining confidence to persevere in experimenting in their teaching practice with new technologies through discussion in the course and after the course with colleagues the participants or mobilising network in collaborative discussions to develop solutions.	Theme 3: Creating new possibilities for learning in professional networks

the discussion that follows. These three broad themes emerging from the analysis are the following ones: (i) generating and deploying new understandings; (ii) experimenting and teaching with new tools and strategies; (iii) creating new possibilities for learning in professional networks (see Table 6).

4.1. Generating and deploying new understandings (Theme 1)

The participants were exposed to learning theories, teaching perspectives, activities that required knowing and reflecting on current trends of technologies in higher education, and the way professional fields are transformed by them. In the interviews, they

mentioned how they drew on the concepts and ideas from the course to rethink existing problems in their teaching planning and more generally the presence of technologies at their institution.

In particular, they described their sense of valuable outcomes in terms of new perspectives and forms of sense-making about technology in education. The useful resources of the course were depicted as 'eye-openers' and 'informative' 'realisations about technology' that were 'making understanding clearer', 'sharpening the toolbox' and making visible 'what you don't know' about technology and education. An example is in the excerpt below:

> I was quite shocked hearing some of the lectures within the slot on Technology in Education [...] about how it has been for a hundred years and how the development has been historically and where we are now. Because I had never thought of it that way, that was really an eye-opener.
>
> (P5)

Some teachers also referred to the pedagogical content and the peer discussions as challenging their ideas of 'good learning'. In more than one case, the participants compared Teknosofikum with other professional training courses at their institutions, mentioning that the course felt like 'a journey' that may require 'experimentation' along the way. In the excerpt below a teacher describes reflecting on different theories of learning encountered in the course.

> In the first workshop, I thought transmission is [expletive]. It's all about the activities. Then I realised, from talking to the other participants, that transmission is not 'bad'. Too much is bad because you want to enable the students to do something with that knowledge, but they can't just go out and fix the code [...]. I just completely misunderstood the role of transmission. That clicked for me.
>
> (P13)

Most participants mentioned that they introduced concrete changes in their teaching plans after Teknosofikum. They referred to concrete actions to address a specific challenge identified during the course. One participant, a course manager for an undergraduate course, argued that the most useful takeaway was learning how a face-to-face course can be augmented with online teaching. An insight he took forward by re-designing the course to include hybrid elements. He explained:

> I think that hybridisation of a present physical, in-person learning with digital learning, trying to incorporate a bit more of a hybridised model [is a valuable outcome]. We haven't decreased the number of in-person, we haven't substituted that, we've kept that the same, we try and do more every year, and we're adding on layers, and it's more of an optional thing for students [...] It gives the options for those that want to kind of delve a bit deeper to get that, and also for those that perhaps can't always be there physically to be able to get like supplementary education on top of that.
>
> (P2)

Another illustration comes from a participant who describes how the knowledge gained in the 'computational thinking' module positioned her differently towards students' technological literacy and became enmeshed in her thinking about developing such work with the students.

> We're working on some development projects that have to do with technology attached to the professions. Some of the input I got [from Teknosofikum] I thought was relevant as further background information and inspiration. For example, the module of computational thinking was one, and some of those things helped me get a deeper understanding of what we're talking about, [...] how we teach our students technological literacy.
>
> (P14)

4.2. Experimenting and teaching with new tools and strategies (Theme 2)

The participants shared that they used both pedagogical and technological tools that were part of the course. Some mentioned hoping to implement these tools in the future to bring about changes in teaching or they said they were in the process of 'trying out', 'testing' and 'piloting' new tools. What emerged in this second sub-theme is the participants' capacity to use available resources in reflective ways, not only as additional elements to their existing practice but rather as new strategies.

One teacher, for example, found the exercise of the mud cards effective in activating 'shy' students in his class:

> I was struggling a little bit [...]. I didn't really know how much people were helping each other out or sharing information. I did a little bit of group work earlier, but people seemed kind of shy [...] but then also actually for myself as a teacher to better gauge what the students are thinking about, are they following what is going on so, the mud cards [an exercise] yeah when I saw that topic I thought immediately oh that is something I want to do.
>
> (P2)

Similarly, another participant piloted an exercise with his students and developed it to fit his teaching context:

> I still haven't used any of the technologies but I'm very fond of the jigsaw learning activity. I got that from [Teknosofikum] and I tried it out [...]. I evaluated it with my students afterwards, and together we came up with improvements. Because the jigsaw requires you to have different similar concepts that are of equal difficulty. That was a realisation! Together we came up with a

> recommendation that when you do the jigsaw, you rank them in order of difficulty and then you make students pick themselves and then you need to fit that in, so what if not everyone picks the difficult one
>
> (P13)

In many cases, the interviewees described how they employed concrete technological and pedagogical tools to address an existing problem in their teaching practice. One participant discussed how using a digital tool enabled him to get feedback from students and adjust his teaching instead of waiting for the usual practice of student course evaluations at the end of the year. This, he argued, transformed how students perceived the course and as a result, the students took the course attendance more seriously.

> I'm running small courses around the school. I'm not having a semester that I'm following. And that's quite distressing because then I can't get feedback to develop my teaching in real-time. I have to wait one or two years and that's a long time. But with Teknosofikum I used some tools that were shown such as [digital feedback tool] to try to get real-time polls from my students and what was good and bad in my workshops. I feel that it gave me something where I could adjust from day to day on how my workshop was being taught.
>
> (P11)

An example of how the interviewees were deploying tools as part of a comprehensive course development is evident in the excerpt below, where the participant created strategies to incentivise collaborative writing and teach professional language of his discipline.

> Teknosofikum opened a new teaching space for me, and it helped me to address some problems that I thought were inherent in the teaching situation and there was no really good way to address [...]. I have these courses where we discuss the language that lawyers use, and that is too complex and difficult to understand, [...] I need the students to work on formulating sentences in a new way, but it's difficult to do in a way where everybody is active, and I can comment on what everybody is doing. There, using a thing like [collaborative digital tool] was the answer to what I thought was an inherent problem in that particular teaching situation. [This tool] is now also an integrated instrument in my teaching.
>
> (P10)

4.3. Constructing new possibilities for learning in professional networks (Theme 3)

The use of insights from the course was for many a collective learning process that emerged from group discussions, interaction, and exchange. For some, the re-purposing of insights for their teaching practice began during the last workshop of the course, when they worked in groups on a problem identified as a teaching dilemma and gathered their insights and feedback. For others, recontextualisation occurred once they were engaged in teaching in their home institution.

In both cases, recontextualisation was sparked by group work, and enabled the participants to understand teaching-related problems in other disciplines, as well as expand their 'pool of ideas' to introduce it later in their practices. This process is exemplified by the quote below:

> The people are all interested and you hear their perspective and see how they think of it and plan to use it. You see their perspective on it and how they plan on using it. Then you get very hands-on things you can take away [...] It's very creative people who go attend the course. It's part of the profession to develop things all the time. So, they come up with good ideas. It might not be an idea you can take and put in your course, but it's still a pool of ideas.
>
> (P3)

A valuable learning experience in the course was also hearing about different perspectives on the identified problem from colleagues from different disciplinary fields and/or institutions. This allowed the participants to have a glimpse of the challenges experienced by their peers and compare those with their experiences. It also allowed for a shared vocabulary and understanding of possible strategies:

> I'm a member of the University Pedagogical Network. I'm also a supervisor of our newly employed teachers [...] and I find [Teknosofikum] very suited. I think we were having [similar] discussions already, but this course made my understanding clearer, my vocabulary more specific. [...] To sharpen my toolbox, it was very beneficial.
>
> (P8)

Albeit a minority, some participants mentioned the transformation in their teaching practices through peer learning after Teknosofikum has ended. For them, the benefit of learning from the course was amplified when they returned to their home institutions, and they met, for example, colleagues who previously participated in the course.

> Some of my colleagues took the online version and we asked what did you do, which ones did you take and what did you get out of it? And for me at least in my department, it mainly revolved around the topics that I just discussed. So, we were trying to translate it between ourselves, you know, what implication does that have on teaching them?

(P12)

However, the lack of peer support once the training course was finished was one of the main barriers to the continual transformation of practice. This is well encapsulated by the following excerpt, where the participant stresses the need for institutional-level support and collaboration to bring about teaching innovation:

> For getting it into the daily practice, it might be nice to follow up with some institution local events where you kind of meet each other and do I don't know, speed dating or something like that to talk to each other about 'Can we do something together to translate this experience?' or just meeting to find out if we have shared challenges that we could work on together.
>
> (P1)

5. Discussion

The discussion will be divided in two sections, following the research questions that have guided our study.

5.1. RQ1: How do HE teachers perceive the possibility to transform their practices after a PD online/hybrid course in digital education?

The study revealed that teachers make sense of their learning outcomes in an online/hybrid PD course in terms of how the course supported them in transforming their teaching practice. The results show three sets of practices that constituted the transformation of teaching (i.e. 'recontextualisation in practice') for the Teknosofikum participants: (i) generating and/or deploying new *understandings* of technology in teaching (e.g. technology as an active agent in the teaching and learning process) (ii) identifying and/or experimenting with new digital and pedagogical tools and strategies in teaching (e.g. digital tools for collecting feedback or facilitating group learning), and (iii) recognising/creating new possibilities for learning in institutional and cross-institutional networks (e.g. using forums and cross-institutional group discussions to collectively reflect on teaching profession).

Comparing the learning outcomes reported by the participants with the initial intended learning outcomes (ILOs) of Teknosofikum, we note overlaps such as focusing on expanding knowledge (1 and 2), engaging in critical reflection (3 and 4), increasing the capability to work with technologies and educational strategies (5 and 6) and developing cross-institutional networks (7). However, the ILOs did not capture the transformation of practice such as the creation of new interpretations of problem spaces that arose from teachers' learning about digital education, or the collaborative sense-making about tensions and dilemmas in teaching that strengthened their professional agency along the course. These results show that there is a need for both individual and collective work for repurposing and refashioning the course resources to make them meaningful for one's own teaching practices. Adopting a transfer perspective would have precluded us from seeing these key additional expressions of teachers' learning.

5.2. RQ2: How does the process of learning recontextualisation occur in their practices?

Drawing on CHAT concepts of recontextualisation and construction/instantiation of purposeful action in teaching activities enabled us to understand how the new learning was recontextualised by the teachers in their daily practices, as exemplified in the following.

First, the results revealed how the teachers were selecting, deploying, and *personalising* the perspectives and insights about digital education from the course (Theme 1). This selection was mediated by their existing and developing interests, workplace challenges and institutional goals (as anticipated by workplace and learner recontextualisation). This led to a variety of diverse 'learning outcomes' that the teachers shared with us and the other participants - some teachers conducted small-scale 'experiments' with distinct ideas and tools while others evolved their teaching practices more substantially by introducing hybrid elements into their courses or developing new ways of teaching technological literacy. These findings suggest that learning in hybrid/online PD not only emerges as a result of designed activities (Goodyear, 2021), but it is also dependent on teachers' intentions and responses to institutional demands. In that sense, the learning outcome of Teknosofikum participants is 'living a life of its own' which, rather than being problematic, 'may be perfectly desirable, if not essential, where the problems of practice are themselves complex' (Bourke et al., 2013 p. 276). Thus, the first contribution of these findings is that a design principle connected to the concept of 'recontextualisation in practice' could be used in future PD courses to account for the different ways course participants make sense of their learning by deploying resources and knowledge acquired in the course for their situated concerns.

Second, we found the pedagogical and technological tools too were contextually *incorporated* rather than *transferred* into teaching practices (Theme 2). While some of the tools and strategies required less effort to deploy because it was clear to the teachers how to use them to address specific challenges, these resources still needed to be tinkered with, trialled and adapted, and so propelled the teachers to (re-)interpret their teaching goals and actions. What became visible was the role of teachers' agency in transforming practice. When confronted with challenging new ideas (e.g. different understandings of the political and social dimensions of technology), they generally embraced the opportunity to reflect on contextual factors such as students' needs, course aims, teaching and assessment goals. Furthermore, the participants felt able to articulate when and why the use of technology was *not* desirable in their teaching,

expanding the possibilities to act by choosing *not* to recontextualise available material and conceptual tools (Mäkitalo, 2016). We contend that this further highlights the need for the 'praxis' principle in course design to support teachers' 'capacity to act' (Guile & Unwin, 2020) in the classroom. This means that digital education courses might benefit from offering a combination of theoretical and critical knowledge of technology and pedagogy in addition to information about available digital and pedagogical tools and resources.

Third, peer feedback and discussions were essential elements of the learning process (Theme 3). There was general agreement among the interviewees that without online/on-site workshops, synchronous meetings, and compulsory group activities during the course, it would have not been possible to achieve valuable learning on technology. The cross-disciplinary and cross-institutional network represented a pivotal element of change (see also Sannino et al., 2021), and the collaborative aspect of Teknosofikum was the one that made the course a safe space for experimentation (Pischetola & Møller, 2023) with different interpretations of the relations between technology and teaching. In this way, recontextualisation proves to be optimally done in a team with peers (McArdle & Coutts, 2010). One of the identified weaknesses of Teknosofikum, however, was highlighted by the participants who lamented the loss of network once the course was completed or expressed how they were grateful for other colleagues from their institution having attended the same course. This aligns with suggestions that professionals need digital education provisions that are future-oriented (Jaldemark et al., 2021), that focus on enabling the emergence of digital communities of practice (Abedini et al., 2021) and transformation of practices through hybridisation from professional networks (Hefetz & Ben-Zvi, 2020) long after the end of a PD course.

The limitations of the study come from the qualitative methods of data collection and analysis and a case-based approach that focuses on a higher education system of a highly digitalised society. This can limit generalisations to similar contexts only. While the findings are context-specific, they highlight important conceptual issues regarding professional development in academia. Possible further research would include mixed method data collection, and a broader more heterogeneous sample of 'cases' by including other countries in the project and evaluation.

6. Conclusion

The paper suggests that for digital education courses to successfully support the development of existing teaching practices, a shift of focus from transfer to transformation may be necessary. The approach we suggested centres on the idea of recontextualisation of learning and requires teachers to articulate, address, and re-think (collaboratively) the challenges encountered in their work. In the case of the study presented here, we found it also valuable to include in the course design an evaluation approach that considers the possible misalignment between predefined/intended and unintended/actual learning outcomes, as this perspective might enrich the idea of learning outcome as result of the personalisation of the encountered resources.

This multifaceted approach to the design, pedagogy and evaluation of a PD course in digital education could productively identify how teachers *implement* their new knowledge in their teaching (Bennett et al., 2022) and would contribute to making visible the labour that goes into this implementation (Hayes, 2016). Practical suggestions include designing PD courses with plenty of peer learning opportunities, enabling the creation of networks and special interest groups that would 'outlive' the duration of the course, designing a curriculum that combines theoretical, practical and critical knowledge and skill, ensuring open-ended activities that invite participants' agency and personalisation of learning and enabling flexible (e.g. modular) and hybrid delivery.

CRediT authorship contribution statement

Jelena Popov: Writing – review & editing, Writing – original draft, Visualization, Validation, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Magda Pischetola:** Writing – review & editing, Writing – original draft, Formal analysis, Conceptualization. **Giacomo Poderi:** Writing – review & editing, Software, Methodology, Investigation, Data curation. **Jeppe Kilberg Møller:** Validation, Software, Project administration.

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Declaration of competing interest

The authors declare there are no conflict of interest or other ethical considerations to report.

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Annex A

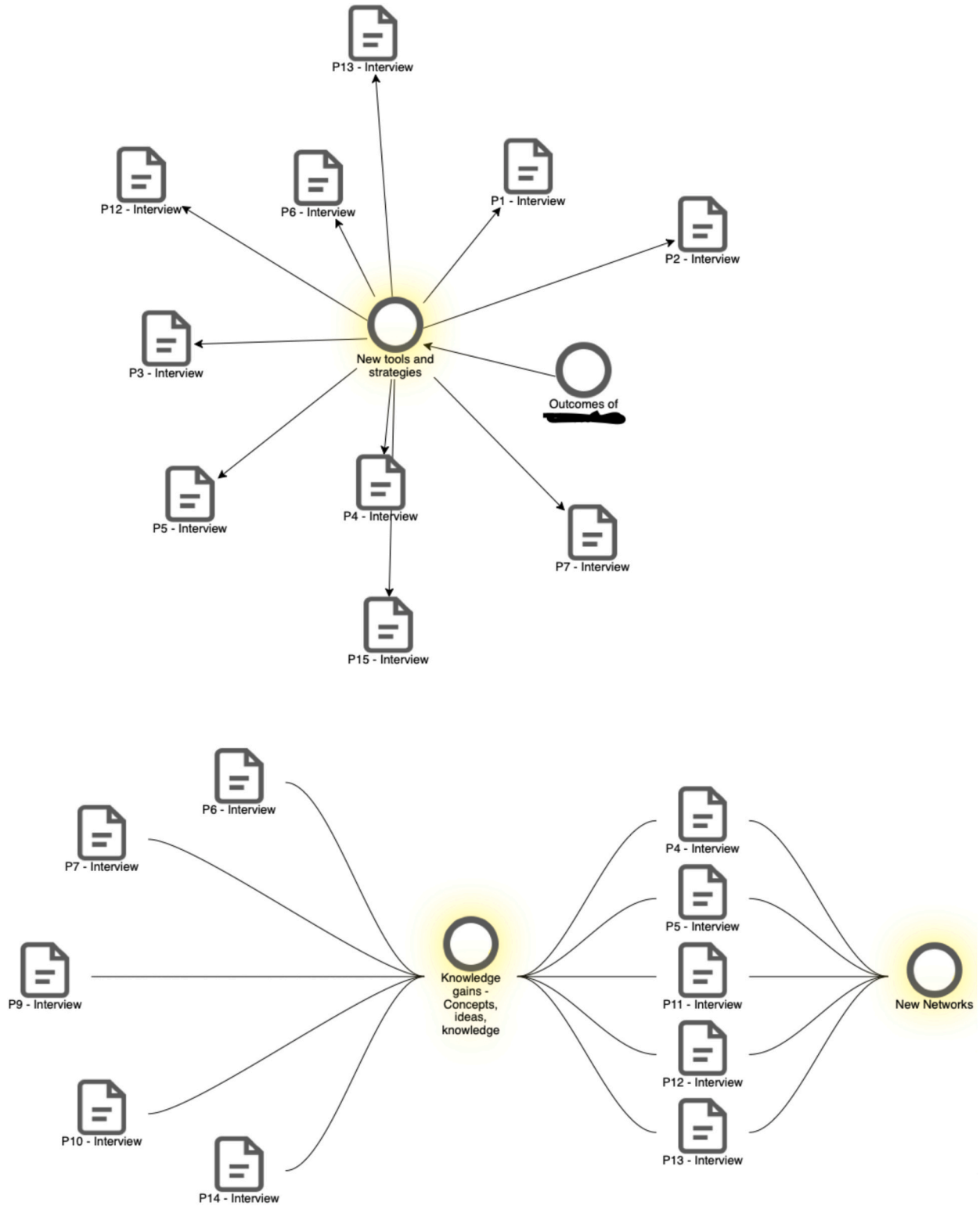

Fig. 3. Nvivo 15. Visualisation of consensus coding in Phase 1.

Data availability

Data are confidential and not publicly available.

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