



Teacher educator in a digital age: A study of transformative agency

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Abstract

Digitalization pushes teacher educators (TEds) worldwide to consider if, and when, traditional educational practices work, and when students and society would benefit from developing the practices. In this article, we investigate some problem situations that emerge when Norwegian TEds and schoolteachers develop educational practices. The context is a 10 ECTS course named “Teacher educator in a digital age”, where the main task required that the participants developed and implemented a project in their classes, which they believed would enhance their own and/or their students’ professional digital competence (PDC). We investigate how, and by what means, they pulled themselves and each other out of different problem situations. Some of the problem situations are presented in academic essays about the projects, while others we observed as they discussed their projects in supervision sessions. Our unit of analysis is “transformative agency,” and we use Vygotsky’s concept of double stimulation when analyzing the data. The study shows that a broad repertoire of resources (i.e., digital technologies, the literature and task, the “learning community” and the national curriculum) stimulates transformative agency and promotes PDC in ways that place the interest of teachers in focus when facing the digital surge. Some of the challenges that remain unresolved prepare the ground for a discussion about how such a course could be adjusted to better meet the needs of today’s schools and teacher education. Research focusing on PDC and transformative agency is highly restricted, and the article is a thematic and methodological contribution to the field.

Keywords

Professional digital competence, Transformation, Agency, teacher education

Digitalization and transformative agency

Digital development creates great possibilities in learning if used strategically. For instance, the Internet provides access to enormous amounts of information, expressed in multiple modalities, and voiced by various people. This can be used to align learning resources to the context, interest, and competence level of the learners; provide students with rich access to perspectives and ideas; promote democracy and critical thinking; and solve complex real-world problems (Binkley et al., 2012). However, it might also cause students to drown in digital archives, waste time on aimless searches, struggle to distinguish verifiable from fake

information, and apply copy and paste strategies when answering tasks. Such phenomena explain why digitalization has epistemological consequences—it influences both how people come to knowledge, by which means, as well as the competencies societies and work life call for (Aagaard & Lund, 2020).

In a recent systematic review about teacher preparation for such digital changes, Starkey (2020) maps different efforts to operationalize the competencies teachers need in a digital age. The review indicates that the term “Professional digital competence” (PDC), which was initially introduced in Norway, is now also recognized internationally.

In the editorial of this special issue, PDC has already been introduced in reference to the Norwegian PDC framework (Kelentrić et al., 2017). However, the concept is still in the making (Almås et al., 2021). According to Starkey (2020, p. 15), it involves “mastering a range of teacher competencies such as being able to teach in a digitally infused context, manage digital learning environments and carry out the broader professional work of being a teacher.” Our take is that it also involves knowledge about how to foster productive learners in a digital age. Furthermore, when epistemic practices change due to digitalization, teachers are left with a choice. They can neglect the tensions that arise due to digitalization and try to resist change, or they can engage in transformative agency. If the educational goal is to prepare students for the society in which we live, the latter option would be the more fruitful solution (Lund & Aagaard, 2020; Lund & Vestøl, 2020). Hence, PDC also involves competence to initiate and engage in innovations and nurture transformative agency. This is crucial to firmly place human interests and the knowledge producing sectors in focus when facing the digital surge (Aagaard & Lund, 2019). Transformative agency can be observed when individuals or groups try to develop practices within changing circumstances. It is typically triggered by a conflict or a disturbance and is produced and maintained in (often) collective and dialectic efforts to break out of these (Haapasaaari et al., 2016).

Even if Norway is among the most digitalized countries in Europe in 2020 (European Commission, 2020), studies about teacher educators’ (TEs’) efforts to transform practices and promote professional digital competence (PDC) seems highly limited. Other focus areas have dominated. For instance, several scholars have investigated digitalization and institutional innovation (e.g., Bates & Sangra, 2011; Lillejord et al., 2018; Selwyn, 2014). Furthermore, a series of studies examine the affordances of digital technologies, such as mobile learning (Pimmer et al., 2016), flipped classroom (Lundin et al., 2018), Massive Open Online Courses (Buhl, 2018), and blended learning designs (Brown, 2016). Numerous studies have also investigated institutional strategies (such as financial investment, infrastructure, projects, and courses), to support the implementation of digital technologies in educational institutions (e.g., Dørum & Grepperud, 2015; Stensaker et al., 2007). Lund and Aagaard (2020) touched upon efforts to develop epistemic practices in education, observing that despite the fundamental impact digitalization has on epistemology, TE still tends to engage in the *use* of digital technologies and less in identifying problem situations and training students to break out of them and innovate epistemic practices. Brevik et al. (2019) argue that student teachers and TEs need to know how to engage in “transformative digital agency” to be prepared to work in a digital context, and they managed to design a course in which student teachers obtained such experiences.

In this article, we investigate some problem situations that emerge when 18 Norwegian TEs from a University and three schoolteachers engage in transformative agency and try to develop educational practices to the better for their students learning. They do this in a course named “Teacher educator (TE) in a digital age”. The main task throughout the course was to develop and implement a project in their class, which they believed would enhance

their own and/or their students' PDC.¹ Their choice of projects was influenced by problem situations they faced. Consequently, the issues addressed varied, ranging from investigating how music technology influences students' guitar learning, to the design of student active online learning lessons. We analyze texts and video observations of supervision sessions where the projects are discussed to answer this research question: *What characterizes the problem situations teacher educators and schoolteachers address when they design and implement PDC projects, and what are the resources used in efforts to solve the situations?*

Context

The course, "TE in a Digital Age", examined in this study, was developed in a large R&D project (www.ludo.usn.no) funded by the Norwegian Ministry of Education (2018–2021). Two of the authors were project leaders, and designed the course in collaboration with a schoolteacher. Together with a fourth colleague, we were also the course leader team.

The course was designed to answer specific challenges in Norwegian higher education (HE). First, we wanted to institutionalize the development of PDC, since the responsibility for digital development in HE had been criticized for being left to individual enthusiasts (Gjerdrum & Ørnes, 2015; Kofoed et al., 2019). Second, we wanted to stimulate the participants to take a research-based approach when developing their educational practices, because scholars had found that arguments for utilizing digitalization in education often came from policy documents instead of research (Aagaard et al., 2018). We therefore formalized it as a master's course with clear academic expectations, and the participants had to document and discuss their projects in academic essays. Third, we wanted to nurture critical discussions about epistemic challenges associated with digitalization, for instance, the trend that commercial technology companies have a major impact on educational development in schools (see e.g., Player-Koro et al., 2018). We also challenged the somewhat limited focus TE had had on *how to use* digital technologies in TE (Hjukse et al., 2020), and rather highlight the close and intertwined relations between digitalization and epistemic practices in and across subjects. Last, since we knew from research that developing educational traditions with long historical roots is easier for communities with "networked expertise" than for individuals (e.g., Engeström, 1987; Hakkarainen et al., 2004), we included TEds from campus, but also schoolteachers from the field of practice in our region as students in the course. TEds are supposed to be both productive researchers, professional developers, and "second-order-teachers" (Uerz et al., 2018) preparing their students for work life through being good role models and experts in developing didactic designs. Therefore, including the schoolteachers was a strategic choice. While the teacher educators from campus brought research-based and subject specific knowledge into the classes, the schoolteachers brought highly valued experiential knowledge from teaching in schools into the groups. In the course, the participants were divided into "learning communities" to help them move forward in their projects and in general support them in dealing with the complex expectations that follows from being a TEd. In the methods section, we elaborate on the course design.

1. The participants were presented the National Framework for PDC (Kelentrić et al., 2017), but their conceptual understanding was not limited to this framework.

Our theoretical point of departure

Our theoretical point of departure is sociocultural and, as mentioned, our unit of analysis is transformative agency, which is a dialectic process and not a capacity or a property of a person (Engeström et al., 2020). Transformative agency as process is typically triggered when people face “disturbances, conflicts and contradictions in the collective activity” and involves “joint activity by explicating and envisioning new possibilities” (Haapasaari et al. 2016, p.233). It goes beyond the individual, and we recognize it when the observed teacher educators and teachers try to solve challenging problem situations that do not have obvious or correct solutions; examine these; try to deal with them; and thereby resist that institutional futures are given and envision alternatives. An example is a teacher who faced the challenge of figuring out if and how aesthetic learning processes can be moved online due to Covid-19. Such processes require breaking established habits and creating new ones. Often numerous, repeated, and small implementation efforts are needed (Sannino, 2020).

Following Lund and Vestøl (2020), Vygotsky’s concept of double stimulation is useful when studying transformative agency. A brief explanation is that a problem situation that is disturbing and triggers conflict (maybe even double bind) represents a first stimulus (S1). The resources learners turn to in order to solve the problem situation is a series of second stimuli (S2). When these are put to use, the learner gains control of the problematic situation and transforms it into an understandable and manageable one (Sannino, 2020). Sannino (2020) uses anchoring as a metaphor to describe double stimulation. Picture that you are on a boat which is aground or has come into troubled waters. You face an S1 that requires action. You can throw a heavy anchor to keep the boat stable and “in place.” You then «anchor backwards» in an effort not to move, but if you “anchor forward” instead, you could haul the boat to a safer place. To do so, you need to use the kedge anchor, and try to hit ground so you can pull the vessel out of the problem situation. The kedge anchor is a metaphor used to illustrate an S2, while warping, which is the process of hauling the vessel, illustrates transformative agency. What makes a resource an S2 is if it helps people to solve or break away from the S1. In our case, an S2 can be a range of digital artifacts, questions from colleagues, knowledge types (subject specific, academic, political, and experiential) that are shared, literature, time, and so on, as long as they are “warping.”

The S1 <-> S2 relation is dynamic and dialectic, and captures the processes of transformative agency, not merely the outcomes (Lund & Vestøl, 2020). In our project, the approach makes sense because developing PDC and coping with epistemic possibilities and challenges in a digital context calls for teachers who both initiate and engage in transformative agency. This position implies, as Stetsenko (2017) put it, that the world we study is in constant change because of people’s effortful, intentional ways of being, knowing, and doing. Consequently, “we-know-the-world-as-we-change-it” and “we-come-to-be-as-we-change-the-world” (Stetsenko, 2017, p.197). A consequence of such a position is also that we “move away from the researcher’s responsibility to capture the world as it is” and rather study the “world as it is coming to be” (Engeström et al., 2020, p. 6).

Method

This is a case study. Case studies provide nuanced understandings of phenomena as well as possibly unanticipated results and new questions of relevance as a case unfolds (Yin, 2009). Our case gives us access to study learning processes in a course designed for teachers involved in TE (18 TEDs from campus and 3 schoolteachers). Since most courses about teaching in European HE gathers participants from across educational programs, this course and

thereby also the case is unique. Furthermore, as the interest in PDC seems to increase internationally (see e.g., Melash et.al., 2020; Starkey, 2020), a study about efforts to promote PDC and transformative agency in TE should be of relevance beyond a Norwegian context. Also, we answer the need for micro-analysis of discourses and activities when teachers engage in transformative change efforts, as requested by scholars (Lund et.al., 2020). We contribute with knowledge about the problem situations TEds and schoolteachers face, and their efforts to engage in transformative agency as they develop PDC and cope with an educational context in constant change due to digitalization.

Participants, course design, and data material

The data were gathered from the course “TE in a Digital Age” (10 ECTS) in spring and fall 2020. Table 1 summarizes the case and data material.

Table 1 Case and the Course Design

	Participants	Course leaders	Course Activities	Tasks
Spring 20 (Class 1)	9 Teds 1 schoolteacher	3 Teds (with interdisciplinary PDC expertise) & 1 schoolteacher	4 whole day seminars with the whole class	Project descriptions Academic essay Podcast
Fall 20 (Class 2)	9 Teds 2 Schoolteachers		2 online supervision sessions in groups (3-4 participants, one about the project idea and one based on an academic essay about the project.	
Data	21 course participants	4 course leaders	12 video recordings of supervision sessions (12 x 3 hrs. total: 36 hrs.)	20 projects drafts 20 academic essays

All the students in the course were included in the study, and participation was based on informed consent, reported to the Norwegian Centre for Research Data. As the table shows, only three of the informants were from the field of practice. One reason why most participants were TEds from campus was that enhancing PDC was a pressing institutional need. Even if all the participants got their teaching workload reduced by 20% to join the course, TEds from campus also had the clearest incentives for participating, such as strengthening their opportunities for academic career advancement. In addition, it was difficult for schoolteachers to participate due to Covid-19.

The data consist of texts about the participants’ projects and video recordings from supervision sessions in smaller “learning communities.” The sessions were led by the course leaders, but the course participants were mainly responsible for feedback and discussions, and they prepared by reading each other’s texts.

Analytical process and quality actions

We analyzed the material inductively and deductively. First, we made an overview of the topics in the different developing projects based on the written texts. These revealed a series of S1s that the participants wanted to solve through their projects. When analyzing the video recordings, we discovered even more S1s and S2s in play that warranted further investigation. Transformative agency emerged as a useful unit of analysis, and we put the dialectics of S1–S2 relations (Engeström et al., 2020; Lund & Vestøl, 2020) in focus when we analyzed the entire dataset systematically.

In our case study, the S1s are problem situations that the participants want to solve through their projects or face when working with them. The S2s are various resources they use in efforts to solve the situations, for instance various digital technologies. According to Lund and Vestøl (2020), S1-S2 relations have explanatory power because they can help us to understand why people sometimes resist change or how they break away and, in effect, potentially transform original problem situations into a springboard for further action.

In the analytical process, different knowledge types emerged as potential “keg anchors.” We therefore developed an observational scheme in which we noted references to policy documents, to experiences from schools or TE, to research-based knowledge, and knowledge about both how to conduct research and development projects. We used the overview to study if and how these resources were used in efforts to solve S1s. In an open column, we noted sections to transcribe because these included utterances or dialogues recognized as empirical carriers of typical S1 <-> S2 relations. All the authors collaborated to identify categories, discuss their relevance, select sections to transcribe and determine how we understood and used them.

We analyzed how transformative agency unfolded through the struggles of TEds in a course that two of us developed and taught. Combining such roles is common when working with transformative agency (Engeström et al., 2020; Sannino, 2020), for example, through stimulating communities to identify problem situations. As “insiders,” we know the field very well. This inside knowledge is used to promote rich rigor, and describe the relevance of the course. Furthermore, it has enabled us to unpack the intentions with developing the course design and present thick case descriptions, also this in line with quality criteria for qualitative studies (Tracy, 2010). Selective perception is a risk, for insiders. Therefore, the third author, an “outsider,” was particularly responsible for questioning preliminary findings, stimulating a critical approach, and challenging potential subjective values in all the collective analytical phases.

Analysis and Results

The analysis has revealed a nested and dynamic system of S1s and S2s. First, we summarize the repertoire of problem situations that the participants explicitly address in their projects, before digging deeper into some dialectic S1 <-> S2 relations in the processes that we recognize as transformative agency.

Problem situations (S1) the participants address when they design and implement projects

When analyzing the various problem situations that the participants addressed through their projects, two focus areas emerged: The participants’ projects were mainly developed to solve epistemic problem situations that were either *subject related* or *didactic* in character. Further, we identified five categories indicating the participants’ main motives. Table 2 presents the categories, including an overview of the digital resources that emerges as S2s in the different projects.

Table 2 Overview of the S1s in the Developing Projects: Main categories and Subcategories

Focus areas	Motives	Problem Situations (S1)	Digital Resources in Use
Subject-related challenges	Strengthen students' subject-specific competencies	Weak knowledge about species diversity (Natural science)	Apps to determine species (e.g., Artsorakelet)
		Weak skills in their second-choice form of Norwegian (L1)	Apertium (translating tool)
		An increasing need for source awareness (Social studies)	Digital learning trajectory
		An increasing need for historical thinking (Social studies)	(None—theoretical reflection)
		An increasing need to learn about programming (Mathematics)	(None—analogue programming was chosen)
		Finding ways to promote students' historical competence (Social studies)	Minecraft (compared with physical construction activities)
		Finding out what newly qualified teachers need to prepare for a 1:1 classroom (Interdisciplinary)	(None)
	Strengthen the subject-specific PDC of TEds	Weak knowledge about the strengths and risks associated with using digital technologies in music education (Music)	GarageBand and YouTube
		Determine how Google Earth can be used to learn about geological phenomena (Natural science)	Google Earth
		Lacking criteria for assessing animation (Arts & crafts)	(None)
Didactic challenges	Get students to work more actively with subjects	Online students are not active enough (Natural science)	Padlet
		Find ways to reach students with flexible learning activities to meet needs under COVID-19	Learning trajectory including Mentimeter
		Students need to prepare better for class (L1)	Video reflection
	Move practical aesthetic learning processes online	Establish how aesthetic learning processes can be taught online (Pedagogy)	Padlet's Timeline with various tasks and multimodal content
		Determine how students can learn physical activities online (Physical Education)	Video documentation
	Support learning processes	Better and faster support for students' learning (Arts & crafts)	Knitting apps and video instruction
		Develop knowledge about digital support structures in exploratory work (Natural Science)	Google, Bookcreator, Artsorakelet (app for identifying species), Padlet, etc.
		Socialize students better through philosophical dialogues and get knowledge about their understanding (Religion)	Kahoot and Mentimeter
		Analyze swimming process in detail as point of departure for peer feedback (Physical education)	Video
		Better align the teaching to the various needs in a class (L1)	Video (Flipped classroom)
Design teaching aligned to the needs of gifted students in a mixed-age class (Mathematics)	YouTube		

Table 2 simplifies the case, and the categories are not indisputable. For instance, most participants have several motives for developing their projects. However, we categorized them based on what was prominent in the participants' discussions and descriptions. Furthermore, a situation can appear as an S1 for one person and a less pressing problem situation for another. The listed S1s are problem situations that the course participants chose to spend 5 months examining, discussing, and analyzing, in collaboration with colleagues. Most of them explicitly said that they struggled, for example, with being a good teacher online, or finding ways to transform traditional performative lessons (like PE lessons or drama lessons) into online lessons. These clearly faced a pressing need to act, without clear answers about how. For instance, Ethan, a music teacher, observed the growing use of digital resources for both teaching and playing music, and investigated the potentials, but also the risks. Others seemed less challenged by pressing experiences, but rather triggered to transform by observing others' promising practices that helped them envision alternatives to their own. For instance, Olivia had heard about Google Earth, and through her project experienced that she could travel to Iceland and the Himalayas with her class and study geological phenomena in much more realistic and student active ways that she had been able to before.

Even if all the participants engage in transformative agency, the change processes were not of a revolutionary character. They typically rooted the projects in established knowledge and experience. For instance, Charlotte, who had worked with animations for years, addressed the challenge that teachers from across subjects lacked criteria for assessing animated movies. Mark, a schoolteacher, observed that two of his 10th graders were performing much better than the others in math and wanted to see if YouTube could help them progress better at their own pace and with suitable challenges. Those with a Ph.D. tended to reapply theoretical concepts used in their previous projects.

All the participants needed inputs to visit new terrains. As the right column shows, a broad repertoire of digital technologies was in use and provided them with both ideas for how to develop their practices and solutions to their S1s. The academic essays indicated that they mostly identified meaningful ways to implement the technologies. For instance, Mona, whose S1 was to design an online PE course, solved the situation by developing deep-learning tasks and she realized that she could easily observe her students' skill progression through video documentation and written reflection.

Resources used in efforts to solve problem situations

In the following, we uncover other resources that the TEds used to pull themselves or each other out of the different problem situations in their efforts to develop "forward." Three resources are most clearly applied as S2s pushing the projects forward: the research-based approach, the "learning community," and the national curriculum for schools.

The research literature and the academic essay as potential S2s

When the course participants started to design their projects early in the semester, they lacked research-based knowledge about PDC. As the main task was to conduct an R&D-like project and write an academic essay about it, they were pushed to approach PDC literature. All the participants requested, and many suggested, relevant research articles during the supervision sessions. The video recordings revealed the role research literature and the academic essay played as potential S2s nurturing transformative agency. The utterances in Table 3 illustrate typical S1 <-> S2 relations in the material. We contextualize and analyze what is said in the right column.

Table 3 Research-based Approach as Potential S2

Utterances (emphasis added)	Comments
<p>Mary: The most important thing I have to do is <i>to find a direction</i>... What kind of PDC perspectives interest me. Because there is a lot I can be interested in as an L1 teacher, but now I must try to <i>focus on what kind of PDC perspectives I should choose</i>.</p> <p>Erica: I have found some articles that I keep next to me and that I should start reading. Because <i>otherwise it is not so easy to get any new thoughts</i>.</p>	<p>Mary’s project was designed to get a better overview of her students’ knowledge and give them a more active role in class. In response, she developed a digital learning trajectory. The quote indicates that the PDC literature is an additional S2 as it provides her with perspectives and direction when designing and evaluating the digital resources she develops. The same seems to be the case for her colleague Erica, who acknowledges the transformative power of academic literature when she states that it is not easy to get any new thoughts without reading.</p>
<p>Ava: I try as best I can to read these articles and things like that. But it is... the vast majority are in English. I think it is <i>heavy</i>, and there are <i>many theoretical terms</i>... I think... I’m relatively good at English, but <i>I fall short</i> and I kind of sit with Google translate... So, <i>I struggle</i>, I just have to admit it. <i>I find it difficult</i>. A lot of this... a lot of these... Yes, <i>but that’s my challenge</i>, then. That’s how it is.</p>	<p>Ava, one of the schoolteachers, finds reading the academic articles heavy and difficult. Emotional statements like “I fall short,” “I struggle,” and “I find it difficult” indicate that, for her, reading research literature generates a problem situation (S1). This is in clear contrast to the above participants.</p>
<p>Mark: I have in a way <i>triggered a system for myself that I would not necessarily have triggered without being here</i>. So, I have in a way <i>got something useful</i> then, which I will take with me further.</p>	<p>Mark, one of the other schoolteachers, repeatedly reminded his class that he was a practitioner, not a theorist. He also struggled with the academic approach, but in this quote, he admits the value of it, as it has “triggered a system” that he believes will be useful also in the future. This indicates a transition that was worth the struggle.</p>

Even if reading research literature seems to provide useful directions for the projects and represent an important tool for thought, Ava’s comment reveals that such literature is not necessarily an S2 but can also represent an S1 if it feels inaccessible. We also found that methodological issues, research ethics, and the academic essay as genre generated insecurity among some, depending on their former academic experience (which varied from nothing to quite extensive).

Analyzing the overall data indicates that the academic approach in most cases was helpful and that both the research literature and writing an academic essay about the projects usually turned into S2s. Some even went through a transition as the academic approach at first seemed resilient and took shape as an S1, but later turned into an S2 providing support and ideas and helped them distance themselves from the immediate surroundings, recognize challenges and possibilities to intervene, and enhance their critical and reflective stance toward digitalization.

The “learning community” with its questions and reflections as S2s

The diverse competence that the groups possess promoted discussions and reflections, for instance, when one of the participants, Sophie, wanted to solve the problem that student teachers had weak skills in Nynorsk, their second-choice form of Norwegian (S1). She called Nynorsk “a child of pain,” and her students’ weak skills worried her deeply. To resolve the situation, her students translated texts with different levels of complexity (song texts, texts from Wikipedia, etc.) from Bokmål, their first-choice form of Norwegian, to Nynorsk using Apertium (a translating tool). They evaluated the qualities of the translations, identified mistakes, and reported shortcomings to Apertium. Below, we see how a colleague and the course leader responded to this and challenged, questioned, and supported Sophie.

Table 4 Questions and Knowledge in the “Learning Community” have as Potential S2s (Part 1)

Utterances (emphasis added)	Comments
Erica: I'm very <i>traditional</i> ... and... I have talked to a number of language teachers who... say that their students use this (Apertium) a lot in school.... They say that it is so good that... if students use it, then they will get few errors... and that it implies that... they go through school... and <i>hardly learn Nynorsk</i> So, one thing I'm wondering about, then, is <i>what are the consequences</i> ... of spending time on this in TE?	Erica positions herself as “traditional,” and when she asks about the consequences of Sophie’s project, she hints about whether it is risky. She refers to the many teachers in schools who believe that use of Apertium might result in students who go through school without hardly learning Nynorsk. If Erica and the teachers she has spoken with are right, using Apertium could strengthen instead of solving Sophie’s initial S1: students’ weak Nynorsk skills.
Sophie: I think that the teachers must use... they [student-teachers] are supposed to become junior high schoolteachers. They <i>are going to teach their students to use it</i> [translation tool] <i>in ways that... they themselves have learned</i> .	Sophie does not respond directly to Erica’s input but reflects as a second-order teacher and indirectly rejects her worries. She suggests that student-teachers need to learn to use such tools <i>in ways that</i> are meaningful, to qualify them to teach their coming students to use tools in learning-enhancing ways.
Anna: We know that translation robots exist, and should we then tell the students that they are not allowed to use them? Or should we find the good ways to use them? I do not believe that we will get anywhere by saying “avoid using this!” We may have to rethink how we teach the students (Nynorsk)... and I think that the task where you let the students use the tool, evaluate, and come up with suggestions for improvements... can also be applied in schools.	Anna, the course leader, follows up and identifies the choice teachers face: Forbid the use of digital technologies or find good ways to use them? The question generates reflection and becomes an S2. Transformative agency is recognized when Anna explicitly resists that futures are given, stating that “we may have to rethink how we teach the students.” She imagines an alternative future in which Sophie’s task makes sense in TE, but probably also can be “applied in schools.”
Sophie: It started with me asking the students if they wanted to become really good at Nynorsk, and they said “Yes!” And I said, “Then we can do it—we can become good!” And it was interesting because I think people want to... that is... to get to a level where they think that I can do this quite well!	Sophie follows up by sharing her knowledge about students’ motivation for learning Nynorsk. When asking them if they want to learn it, they answer “Yes!” We read this as an indirect comment to Erica’s worries and that Sophie’s experience is that students want to learn things quite well.

The micro analysis of the discussion shows an S1 that most of the participants recognize—that digital technology use can promote learning but also threaten learning processes. Based on Erica’s knowledge, the teachers observe that Apertium deteriorates students’ learning. However, if Sophie is right, the tool might become an S2 solving a subject-specific threat if used in meaningful ways. Her final comment indicates that the task and the technology in combination are kedge anchors (S2s) that help her to “warp” out of the S1.

A backdrop for the next discussion is that Norwegian municipalities decide whether they want to implement 1:1 coverage of tablets in schools. The stakes are high and those who invest often collaborate closely with the commercial companies who sell the gadgets during implementation. Ava, whose S1 is figuring out what newly qualified teachers need to learn to prepare for a 1:1 classroom (every student has their own iPad), is doing this on behalf of the municipality. In Ava’s first essay draft, she wrote about the importance of teachers’ positive approach to this 1:1 investment. The discussion that follows shows the role questions and critical reflections in the “learning communities” play in identifying S1s and bringing the projects forward. The following utterance is from a dialogue when Sophie objects to Ava’s way of writing about digitalization in schools.

Table 5 Questions and Knowledge in the “Learning Community” have as Potential S2s (Part 2)

Utterances (emphasis added)	Comments
<p>Sophie: You say that it has been <i>absolutely crucial</i>... that teachers have <i>good digital competence and faith</i> in the process [of implementing 1:1]... You say in a way that to be part of this, you must <i>believe in it</i>, and it is almost <i>religious</i>... And somehow, I think that it seems like... <i>the municipality has faith</i> in this digital change, and so should the teachers... And maybe they don't? Everyone of course agrees that we should use it [the iPad] if it provides increased learning, ... but it is not always suitable.... It is something to do with the <i>hallelujah mood</i>.</p>	<p>That idea that teachers should have <i>faith</i> in iPads obviously provokes Sophie, and through her objection, an S1 is identified. Expecting teachers to take a “religious” approach to iPads in school is identified as a disturbing conflict. Sophie reflects about teachers that are pushed to believe in digitalization, but maybe they don't? The question triggers a fundamental discussion that generates transformative agency through joint efforts to envision alternatives to the “hallelujah mood.”</p>

Sophie’s input engaged the whole group in considering the importance of critical awareness toward digitalization in education. Ava explicitly said that the input motivated her to reflect more critically on digitalization in the future. Her final essay and statements toward the end of the semester also indicated that questions like Sophie raised *and* the research-based approach in the end became S2s as it triggered her awareness and provided her with arguments for taking a more critical and analytical stance toward digitalization in schools.

In the first drafts and supervision session, surprisingly few TEds referred to the field of practice and society when they argued for their projects. However, the schoolteachers were typically interested in and sometimes questioned if and how the practices developed could be implemented in schools. Often these questions were not answered directly, but the TEds’ final texts indicate that the inputs had made them think about why their projects were of relevance to schools.

A few times, participants suggested for their peers to apply a specific digital technology or a theoretical concept that they themselves found highly interesting but were ignored. In general, however, collective reflections and in particular questions revealed S1s and triggered the groups to collectively discuss possible solutions that could bring the projects forward. To sum up, most of the participants explicitly expressed that the “learning community” challenged their understanding of PDC and generated ideas and insights of relevance for the different projects. Consequently, this social resource also took shape as an S2 bringing them forward.

The national curriculum as S2

As previous research indicated that policy documents often pushed the development of digital practices in HE, we were particularly aware of references to such documents in both the texts and the supervision sessions. We were first surprised how few times the participants referred to policy documents in the drafts and supervision sessions. Hence, it was particularly interesting to read the final essays in which they tended to show why and how their projects were relevant for schools by referring to their national curriculum. They typically argued that their projects would promote deep learning, critical thinking, computational or source awareness, and support exploratory learning, and so on, issues that are all central in this curriculum. Hence, the curriculum worked as an S2, in the sense that it helped the TEds bridge what they did in the projects to the students’ future profession in schools.

Discussion

What characterizes the problem situations TEds and schoolteachers address when they design and implement PDC projects, and what are the resources used in efforts to solve the situations? We have found that the problem situations are either *subject-related* or *didactic* in character. Further, efforts to solve them involve complex processes that are supported by various S2s presented above. While digital technologies pave the way for new practices, the research literature, the academic essay, and the “learning community” gave direction and triggered critical awareness, and the national curriculum was used to show how the projects were relevant for schools and the students’ future profession.

As mentioned, digitalization in education has usually been left to enthusiasts in Norway (Gjerdrum & Ørnes, 2015; Kofoed et al., 2019). The case shows how promoting PDC and digitalization in programs and subjects can be initiated and supported by an institution. Furthermore, scholars claim that discussions about digitalization in schools and teacher education would benefit from being more subject-specific (Amhag et al., 2019; Lund et al., 2014; Hjukse et al., 2020). Our study shows what happens when teachers from campus and schools identify their own projects and explore various ways to solve S1s that are either subject-specific or didactic. The outcome is two classes that have participated in developing knowledge about subject and context-specific affordances and constraints of digital technology use.

Several researchers have claimed that aligning education to the digital age in which we live calls for teachers who redefine tasks and develop practices that break with certain traditions (Clarke-Midura & Dede, 2010; Puentedura, 2012). Most participants in our study developed new tasks in their projects, even if outsiders might not recognize them as “revolutionary” different from traditional tasks. We could have provided the participants with more ideas for how subject-specific traditions could be transcended and why. However, none of them threw anchors to “stabilize the ship.” Rather, they applied digital, social, and material resources as “kedge anchors” and “warped” in directions appropriate for their students’ learning. They all experienced values and challenges of re-designing didactic practices and engaged in transformative agency triggered by S1s that they themselves recognized.

Through her project, Sophie found that her way of using Apertium motivated her students and engaged them in meaningful language learning processes. Contrary, the teachers Erica referred to found that Apertium could deteriorate students’ language skills. This illustrates why it is hard to answer whether digital technologies are good or bad for students’ learning without looking at the context in which they are used and how. In line with Brevik et al. (2019), we conclude that initiating and engaging in transformative agency is a key aspect of PDC and therefore should be nurtured in TE. The main reason is that developing epistemic practices in a digital context involves complex change processes, including risks. The task that the participants solved provided experience with transformative agency and how different S2s can help them to distance themselves from their immediate surroundings, recognize possibilities for intervention and transformation (Mäkitalo, 2016, p.64), and critically evaluate change efforts.

Furthermore, we have found that there is not *one* solution to problem situations emerging when developing PDC in TE. Even if, for instance, the literature and the academic essay helped participants focus and provided ideas for how to pull forward in their projects, some initially struggled so hard with subject-specific concepts and the English written literature that new S1s were generated. Future course designers could consider the benefit of reading groups, access to more literature in the native language, and learning how to use digital translation tools to boost the potential transformative power of the mentioned resources.

In 2019, a survey was conducted across Norwegian HE institutions showing that lack of time was the greatest barrier for developing educational practices (Kofoed et al., 2019). Further, we know colleagues who find it difficult to be “second-order-teachers” (Uerz et al., 2018), particularly those who have never worked as schoolteachers. Behind the “observed scene” is therefore a warping S2, which deserves attention, that is, the national decision to invest great resources in promoting PDC in TE.

In line with what Lund and Vestøl (2020) suggest, we have contributed with a micro-analysis revealing the problem situations TEds and schoolteachers face and their efforts to engage in transformative agency as they develop PDC and cope with an educational context in constant change due to digitalization. We have shown how double stimulation as concept can be used to identify the many layers of challenging tensions and resources that dialectically relate and cause transformative agency and change in institutionalized practices. However, the transformative agency observed does not imply that promoting PDC in TE (the institutional S1) is solved, leaving the institution in calm and safe water. Nevertheless, the course we have studied focused how to improve teaching and engage in transformative agency. From our point of view, such an approach to PDC development is highly valuable, as it can support the participants challenging endeavor of expanding practices and adapting teaching to a context that also in the future will keep changing. Epistemic practices are always in a dialectic and responsive relation to the context in which they unfold. They are influenced by, but also influence, cultural mindset, history, and the social and material resources available. Consequently, teachers need to know how to identify opportunities and risks associated with digital technologies so that learning and knowledge work stay relevant and goal oriented (Aagaard & Lund, 2020).

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