Transformative agency in teacher education: Fostering professional digital competence

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HIGHLIGHTS

- Student teachers face complex challenges in their future profession, incl. developing professional digital competence (PDC).
- In response, teacher education needs to address the reciprocity of PDC and students' transformative agency.
- We demonstrate how a small private online course (SPOC) integrates PDC, university seminars and practice.
- Student teachers respond to challenges by transforming them into opportunities for their professional development.
- The SPOC fosters PDC development through transformative digital agency, conceptualised as a new PDC pillar.

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1. Introduction

A growing body of research has shown attention to how teacher education connects with professional practice (e.g., Darling-Hammond et al., 2017). Recent research on teacher education (TE) programmes in Chile, Cuba, Finland, Norway, and the United States has shown that the strongest and most effective TE programmes integrate theory presented and discussed at university seminars, and school practice (Hammerness & Klette, 2015; Jenset, Klette, & Hammerness, 2017), while studies also confirm a persistent challenge of integrating components across contexts (Darling-Hammond et al., 2017; Jenset et al., 2017; Lund & Eriksen, 2016). This paper analyses a fundamental part of the development in the TE programme at a large Norwegian university; namely a small private online course (SPOC), which is integrated as a vital component for all student teachers. The SPOC component contributes to integration of student teachers' professional digital competence (PDC) across school practice and university seminars. This has proved to be a challenging endeavour for the student teachers.

PDC is an integrated part of student teachers’ professional development as they are expected to learn how to make optimal use of ICT and make the best of the potential that lies in ICT for teaching and learning. This means for example that student teachers connect academic and experiential forms of knowledge and have “the ability to develop innovative ways of using technology to enhance the learning environment, and to encourage technology literacy, knowledge deepening and knowledge creation” (UNESCO, 2011, p. 8). But this requires teacher education to foster students’ competencies that will be crucial for facing complex and critical challenges, also recognized by the OECD as a central topic in policymaking, education, and research (Csapó & Funke, 2017). Similarly, a review of teacher professional development in articles published in Teaching and Teacher Education (Avalos, 2011) pointed to dilemmas and conflicts arising from the need for teachers to cope with emergent issues such as digitalisation, school–university partnerships and research-based approaches to teaching. The review concluded that “we know little about how pervasive these changes are”, and “that the combination of tools for learning and reflective experiences” (Avalos, 2011, p. 17) might serve to sustain teachers’ professional development and expertise. The present study aims to examine how PDC and transformative agency can constitute productive and sustainable responses to such issues.

PDC demands that teachers – and student teachers – not only adapt their practices to digitalisation, but design and enact learning environments and activities conducive to their students’ learning (Lund, Furberg, Bakken, & Engelen, 2014). PDC is highly contextual and requires student teachers who can assess the affordances of digital resources and connect them to learning objectives to
achieve optimal outcomes. Consequently, student teachers can no longer be mere recipients or executors of educational frameworks, but increasingly have to exercise agency and decision-making in the face of increased complexity. Such agency involves epistemological, pedagogic and subject-specific deliberations (Lund et al., 2014), as digitised information is immediately accessible, can be copied and potentially falsified, and appears as a range of (multimodal) representations of scientific and social processes.

Consequently, we argue that a valid TE requires a refined notion of student teachers’ transformative agency when developing PDC. We understand and use transformative agency as the agents’ (student teachers’) capacity of “breaking away from the given frame of action and taking the initiative to transform it” (Virkkunen, 2006, p. 49). Transformative agency goes beyond the individual and also involves the collective practice in seeking change efforts, often found or needed in situations involving conflicts, contradictions and disturbances (Haapasari, Engeström, & Kerosuo, 2016; Sannino, 2010). TE faces the daunting task of educating student teachers to develop, endorse and enact such collaborative efforts of transformative agency; facing challenging situations in practice involving a problem, conflict of motives, challenge, dilemma, or uncertainty. In particular, how to link and operationalise transformative agency in technology-rich learning environments is a daunting endeavour for teachers and student teachers alike. The present paper aims to identify and analyse such endeavour in order to better understand how to educate agentive student teachers.

A recent systematic review of educational use of ICT in higher education (Lillejord, Barte, Nesje, & Rud, 2018) found that due to inertia in educational institutions, digital resources were commonly adapted to existing educational practices and even behaviourist models of merely content delivery. Traces of transformation, going beyond the status quo, were nearly non-existent. The conclusion was for educational institutions to prioritise professional development. Thus, in the present study, our main aim is to investigate how the SPOC component can foster PDC development across educational contexts and that involves much more than instrumental expertise, cultivating a transformative agentic perspective on digitalisation in TE. Against this backdrop we ask the following research questions (RQs):

RQ1: How does a Small Private Online Course (SPOC) component in a teacher education programme integrate theoretical issues and school practice to develop student teachers’ Professional Digital Competence (PDC)?

RQ2: How do student teachers develop PDC through transformative agency?

2. Context

The SPOC component is part of a five-year Master of Education (ME) programme (for details, see Brevik, Blikstad-Balas & Engelien, 2017; Brevik, Gunnulfsen & Renzulli, 2018) at the University of Oslo, Norway. Student teachers choose two school subjects, and complete professional teaching courses in addition to practice placements in secondary schools. The SPOC component in this study is the SPOC 2 (Table 1), and was developed by the authors; addressing pedagogy, subject didactics, information and communication technology (ICT) and research, to prepare student teachers for developing their own students’ digital competence in the secondary school classroom.

Digital competence has been gradually introduced into Norwegian schools, and as access to ICTs became more common during the last decade, a basic skills framework was developed (Norwegian Directorate of Education and Research [NDER], 2012). The framework applies to all students in primary and secondary education in all subjects. Following a sharper focus on digital skills and how teachers could best prepare their students for learning and participating in everyday life, work and society, the term Professional Digital Competence (PDC) was introduced by the Norwegian Centre for ICT in Education (now NDER). However, most Teacher Education (TE) institutions in Norway lacked a systematic and comprehensive approach to PDC development (Tomte, Kærstein, & Olsen, 2013), with great variety in faculty staff expertise and poorly established PDC at the leadership level. The need for a holistic PDC framework was acknowledged, as only a few TE programmes could articulate what it meant for future teachers to be digitally competent. Following this development, PDC is now a well-known concept in Norway, supported by the Framework for Teachers’ PDC (Kelentrič, Helland, & Arstorp, 2017).

Nonetheless, little is known about how PDC is operationalised in TE programmes in Norway, whether in university seminars or in school practice. One reason may be found in the paradox that “academics appear not to be using a scholarly approach when implementing technology in higher education” (Lillejord et al., 2018, p. 4). ICT is often subject to ad hoc implementation or the result of individual enthusiasts and lacking a scientific basis for its introduction. Consequently, we next turn to selected research and our theoretical perspective and conceptual framework in order to provide a more principled approach to introducing PDC in TE.

3. Selected research

The present study approaches the interface of Professional Digital Competence (PDC) and transformative agency required to prepare student teachers for complex learning and teaching situations that involve options and informed decision making. However, to the best of our knowledge, scientific studies addressing PDC in light of transformative agency are few. Therefore, in the following we highlight some transformative agency studies

<table>
<thead>
<tr>
<th>Term</th>
<th>Five-year integrated Master of Education programme</th>
<th>Components of PDC and practice placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Master thesis in school subject 1 or didactics 1</td>
<td>SPOC 4 and Practice placement: 15 days</td>
</tr>
<tr>
<td>9</td>
<td>Didactics in school subject 1</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Didactics in school subject 1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Professional teaching course (incl. didactics in school subjects 1 and 2)</td>
<td>SPOC 3 and Practice placement: 45 days</td>
</tr>
<tr>
<td>6</td>
<td>Professional teaching course (incl. didactics in school subjects 1 and 2)</td>
<td>SPOC 2 and Practice placement: 25 days</td>
</tr>
<tr>
<td>5</td>
<td>School subject 1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>School subject 1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Professional teaching course</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>School subject 2</td>
<td>SPOC 1 and Practice placement: 15 days</td>
</tr>
<tr>
<td>1</td>
<td>School subject 2</td>
<td></td>
</tr>
</tbody>
</table>

Note: SPOC — Small Private Online Course.
involving digital literacy, before briefly dwelling on one of the more influential models for fostering teachers’ digital competence, the technological pedagogical content knowledge (TPACK) model. This approach serves as a backdrop for our conceptualisation of PDC.

3.1. Transformative agency research

Haapasari et al. (2016) examined discursive manifestations of transformative agency. They emphasised that transformative agency is collective, appears in variations and evolves over time, moving from resisting change towards taking actions to change the activity. In their efforts, they adopted five types of transformative agency, defined by Engeström (2011), and divided the first one into two, ending up with six types: 1) resisting and 2) criticising the current activity, 3) explicating new possibilities, 4) envisioning new patterns or models, 5) committing to specific actions and 6) taking the consequential actions needed to change the activity (see Table 2).

Similarly, Sannino and Engeström (2017) examined transformative agency connected to ICT integration; showing that transformative processes involved not just negotiations, but also going beyond traditional practices. Still, features of the original practice remained, reminding us that transformative agency is a multistep and longitudinal process. Kerosuo (2017) focused on the initiation of transformative agency among professionals, using “transitional episodes” (p. 339) as unit of analysis. These studies are relevant when examining the initiation and enactment of transformative agency among student teachers, while also drawing on recent work on developing a dialectic and dynamic unit of analysis for studying transformative agency (Lund & Vestal, in press).

With the limited number of studies on transformative agency, we see a further need for theorising and unpacking the complexities and implications involved; especially on the connections between transformative agency and the integration of digital resources in TE and student teachers’ professional practice.

3.2. Digital literacy research

A number of literature reviews have summarised characteristics of digital literacy. Iломäki, Paavola, Lakkala, and Kantosalo (2016) analysed 76 papers using different terms and found the most common ones to be digital literacy, new literacies, multiliteracy and media literacy. The conception of literacies in de Oliveira Nascimento and Knobel’s (2017) review of sociocultural digital literacies research within TE connects them to the enactment of social practices. They found that all the studies (N = 34) except one were embedded in coursework, with two conceptualisations of digital literacy: digital literacies as linked to out-of-school practices and providing collaborative and supportive learning. Lankshear, Snyder, and Green (2000) took a comprehensive and principled approach to what digital literacy means for teachers. From a sociocultural perspective, they labelled the juxtaposition of technology and literacy, technoliteracy, practices that have operational, cultural and critical dimensions to be appropriated by teachers. They also connected school and out-of-school practices, a research topic that has raised a lot of recent interest (Brevik, 2016, 2019).

Various aspects of digital literacy were explored in other studies under different names, such as digital competence (Calvani, Fini, Ranieri, & Picci, 2012), ICT literacy (Fraillon, Schulz, & Ainley, 2013), computer skills (Centre for Educational Research and Innovation, 2010), digital skills (Zhong, 2011) and Internet skills (Kuhlmeier & Hemker, 2007). However, these concepts largely reflect learners’ perspectives rather than the perspectives of teachers, teacher educators or student teachers, although a few studies exist on what it means to be a professional digitally competent teacher (Blikstad-Balas, 2014; Gudmundsdottir & Hatlevik, 2018; Gudmundsdottir & Ottestad, 2016; Jimmyannis & Komis, 2007; Lankshear et al., 2000; Lund & Eriksen, 2016; Lund, Furberg, & Gudmundsdottir, 2019). Despite a certain focus on teachers, didactics, classroom practices, and beyond, the literature reflects a multitude of terms and conceptualisations and there is little detailed analysis of the epistemological implications of how student teachers come to knowledge when information is digitised, multimodal, accessible and unlimited. This also holds true for the widely acknowledged and operationalised TPACK framework (Mishra & Koehler, 2006) as reported in literature reviews (Willermark, 2018).

4. PDC as an epistemic framework

PDC is not an established concept or practice. Thus, in the following, we relate PDC to the somewhat broad notion of digital literacy and the more specific TPACK model; positioning PDC in a context that emphasises epistemology and the learning sciences as well as more discipline-specific issues. Such juxtaposition will also make visible the links between PDC and transformative agency. We define PDC through four dimensions—three established PDC pillars (Gudmundsdottir & Hatlevik, 2018) and an additional one based on the theoretical framing of transformative agency:

1. **Generic digital competence** cuts across subject disciplines and specifies the general digital competence that teachers, teacher educators and student teachers need to function as educators in digital contexts.

2. **Didactic digital competence** captures how school subjects are affected and afforded by digitalisation: representations, knowledge practices, communicative ecologies, etc.

3. **Professionally oriented digital competence** is connected to (student) teachers’ professional enactment of PDC: how they design lessons, approach assessment, communicate with colleagues and other relevant parties, conduct classroom management in technologically rich classrooms and continuously advance their PDC.

The fourth PDC dimension is a theoretical contribution of this paper, involving transformative agency:

<table>
<thead>
<tr>
<th>Manifestation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Resisting</td>
<td>Resisting the change, new suggestions or initiatives. Directed at management, co-workers or the interventionist.</td>
</tr>
<tr>
<td>2. Criticising</td>
<td>Criticising the current activity and organisation. Change oriented and aiming at identifying problems in current ways of working.</td>
</tr>
<tr>
<td>3. Explicating</td>
<td>Explicating new possibilities or potential in the activity. Relating to past positive experiences or former well-tryed practices.</td>
</tr>
<tr>
<td>4. Envisioning</td>
<td>Envisioning new patterns or models in the activity. Future-oriented suggestions or presentations of a new way of working.</td>
</tr>
<tr>
<td>5. Committing to actions</td>
<td>Committing to taking concrete, new actions to change the activity. Commissive speech acts are tied to time and place.</td>
</tr>
<tr>
<td>6. Taking actions</td>
<td>Reporting having taken consequential actions to change the activity in between or after the laboratory sessions.</td>
</tr>
</tbody>
</table>
4. **Transformative digital agency** captures (student) teachers' competence in taking initiatives and transforming their practices by selecting and using relevant digital tools. It arises as a necessity when (student) teachers are placed in demanding situations involving challenges or a conflict of motives, thus creating a wish or need to break out of the current situation.

The transformative digital agency dimension is, like the other three existing dimensions, not a singular element without reference to the others. On the contrary, all four dimensions are mutually dependent rather than mutually exclusive. Just as we argue that the Haapasaari et al.'s (2016) dimensions (see Table 2) are partly overlapping, the PDC dimensions are also interrelated. This suggests that (student) teachers need to conduct transformative digital agency when they are teaching their subject (didactic digital competence) or doing other professional duties (professionally oriented digital competence).

The four-dimensional PDC framework connects deeply with the learning sciences and fundamental assumptions of sociocultural perspectives of learning. PDC links theory and practice in that these are not dichotomised but represent knowledge types mutually constitutive of learning and development, the girder of the teaching profession. Using the PDC framework entails a focus on how digitalisation transforms (student) teachers' concepts of knowledge, learning and epistemic practices. Everything can be accessed, copied and manipulated, and through digital networks, we can connect minds and suspend constraints in space and time.

5. **Theoretical perspectives**

Facing and engaging in complex, epistemic work requires informed decision making and an agentive stance (Stetsenko, 2017). Such decision making and agency increasingly require the use of digital resources in order to elicit reliable and relevant information and to connect with people and communities where such information is located. But examining Professional Digital Competence (PDC) as an epistemic framework for responding to the requirements indicated above is not common. One reason may be the lack of theoretical framing. In order to theorise and operationalise transformative agency, we draw on some relevant aspects of cultural–historical perspectives (e.g., Engeström, Miettinen, & Punamäki, 1999). These perspectives address learning as transformation involving reciprocity between the individual and the collective, agents and contexts, and using cultural tools (material, discursive and symbolic) as mediating artefacts for transformative purposes. We aim to capture what agents (student teachers) invest in and struggle with to make sense of challenging situations, make difficult choices, and how they transform such situations. If we want to educate (student) teachers who are not merely executors of the curriculum but can engage in continuous professional development, we argue that insights into transformative processes that lead up to consequential actions are vital.

5.1. **Transformative agency**

Virkkunen (2006) provided an early analysis of how transformative agency could be built and the dilemmas encountered in the process: “breaking away from the given frame of action and taking the initiative to transform it” (p. 49). Thus, transformative agency carries a future orientation and involves decision making with both immediate and long-term consequences. Drawing on Virkkunen (2006), Sannino (2015) argues that there is a need to study how agency comes into being and can be developed. Such agency is not innate in the individual but developed in object-oriented interaction. We aim at demonstrating what such developments entail when student teachers respond to and take initiatives to transform practices. As transforming the object of activity—in this case, fostering PDC as part of student teachers’ professional expertise—is at the heart of this study, we need to focus on transformative agency.

While transformative agency involves new knowledge and competences to be appropriated and related to the student teachers’ education, such agency is often instantiated as springboards for practices to be more fully developed (Virkkunen, 2006). Hence, we need to conceptualise transformative agency at various stages, as well as its state of flux, elusive manifestations, possible directions and resources that agents evoke. A common denominator concerns participants aiming to break away from constraining practices and expanding them despite obvious uncertainties (Lund & Vestøl, in press; Sannino & Engeström, 2017).

5.2. **The principle of double stimulation**

To examine processes of student teachers’ PDC development, we draw on Vygotsky’s (1978) principle of double stimulation, which has generated some promising approaches to studying transformative agency (Ellis, 2010; Lund & Rasmussen, 2008; Sannino & Engeström, 2017). However, Vygotsky never presented a comprehensive account of this principle; it appears scattered and fragmented in his work. Recent research has acknowledged that this principle carries analytic and epistemological properties that make it possible to examine and document agentive processes, and that double stimulation can be understood as a principle of transformative agency (Sannino, 2015).

The double stimulation principle involves a first stimulus (S1) that represents a problem, conflict of motives, challenge, dilemma, uncertainty, etc., which requires transformative agency to resolve the situation. These basically invisible processes can be examined by turning to the (student) teachers’ use of the second stimuli (S2)—that is, resources that are mobilised and put to use in this process of transforming their practice. Thus, double stimulation is not merely a unidirectional effort to appropriate a cultural tool, but represents a dialectic and dynamic activity in which situations and agents undergo transformation.

We deviate somewhat from Vygotsky’s original experimental approaches to double stimulation, where a vital point was to regard S2 as neutral, put to use as the subjects instil it with their own intentions (Lund & Rasmussen, 2008). In our case, student teachers use the Small Private Online Course (SPOC) as a shared digital space with a plethora of resources, tools, or stimuli; the question is which tools are picked up and appropriated by the student teachers. In the SPOC, such stimuli are found in the collaborative design, in the assignments that invite agentive responses and practices, in connections between knowledge domains, and in feedback channels for peers as well as teacher educators—as a series of material, procedural and conceptual artefacts.

As the student teachers’ SPOC work was conducted in parallel with university studies and school practice (see Table 1), they find themselves in a position where they can—or must—make links between PDC, subject didactics, pedagogy and professional practice. This involves breaking out of situations that may feel challenging or critical, but also offering opportunities to be enacted as technology-informed instructional practices. Thus, the SPOC functions as an S1 where student teachers may experience challenges in their teaching. Choices of how to respond to such challenges are available as a series of S2. These resources could be material (the SPOC assignments and resources), social (peers, university staff and school supervisors) and epistemic (disciplinary, pedagogic/didactic,
experience based and conceptual knowledge). It is thus important to see the S2 not as a singular stimulus but a series of stimuli, leaving a trail of (student) teachers' agentic endeavours. In this study, we analyse how such trails manifest themselves as digital traces in the SPOC, and also in a subsequent survey and focus group responses among student teachers.

6. Methodology

The research design draws on mixed methods research (Johnson & Christensen, 2014) by integrating qualitative and quantitative data from the Small Private Online Course (SPOC) at the University of Oslo, an online student survey, and focus groups. The core of our research design is formed by the dialectics in the S1–S2 process: how student teachers respond to the SPOC intervention and seek to transform their Professional Digital Competence (PDC) repertoire (Vestål & Lund, 2017).

6.1. Participants and data

We invited the entire 2017 cohort of student teachers (N = 196) in their 6th term of the ME programme into the study (see Table 1), with 71% (n = 139) willing and able to participate. All participants provided informed consent—and all participant names are pseudonyms. The digital traces included the student teachers’ (n = 139) responses to SPOC assignments, and discussion threads, where they reflected on their PDC development and their general and subject-specific use of ICT for teaching and learning. Immediately after finishing the SPOC the participants were asked to evaluate it through an online survey. The response rate was 66% (n = 92), which is considered a valid rate (Nulty, 2008). This survey comprised five main themes (A–E) with a total of 20 questions, mostly closed questions using a 5-point Likert-scale (from 1 = not at all to 5 = to a very great extent). It also contained five open-ended questions that asked participants to reflect on the usefulness of the SPOC for their PDC development. Based on their evaluation, we designed the interview guide for the focus groups.

The entire cohort was invited to participate in the focus groups, and 12 student teachers were recruited (10 females and two males). In line with qualitative sampling strategies, we used convenience sampling for the focus groups (Creswell & Poth, 2018), as the main rationale for selecting participants was the lack of information about the processes initiated by the SPOC. Following the general rule in qualitative sampling, we attempted to use a sample size for the focus groups that was large enough to obtain saturation, “(i.e., where no new or relevant information seems to emerge as more data are collected) but small enough to conduct a deep, case-oriented analysis” (Johnson & Christensen, 2014, p. 273). Thus, we divided the sub-sample into three focus groups, each represented by student teachers with at least three subjects, and continued interviewing until the new information obtained did not provide further insights. Considering each group as a separate case offered the opportunity to conduct within- and cross-case analyses to get important comparative information. Although a convenience sample, the balance concerning gender distribution and subjects between the overall cohort (N = 196), the participants and SPOC sample (n = 139), the survey sub-sample (n = 92) and the focus group sub-sample (n = 12), make us contend that the focus group sub-sample provide a reasonably representative sample from the overall cohort (see Table 3).

The interview guide considered some of the contradictions in the student teachers’ survey responses. The invitation encouraged participants to express themselves openly regarding challenges and limitations in their SPOC use and any opportunities the intervention might have provided for PDC development in school practice and/or university seminars. All focus groups were video recorded (totalling 4 h and 48.29 min) and transcribed in full.

6.2. Data analysis

Identifying how the student teachers documented and articulated transformative agency and PDC development amounts to capturing an emergent phenomenon. We searched for digital traces of transformative agency in student teachers’ SPOC work, survey, and focus group transcriptions. We identified instances and themes across data sources, and related them to Haapasaari et al.’s (2016) six categories of transformative agency (see Table 2) for analytic purposes. All authors analysed the data, first separately and then together, to ensure a common understanding. First, we analysed the extent to which the six categories appeared in the data material, and tagged each category when identified in each of the data sources. Second, we conducted a thematic analysis that identified how these categories not only occurred separately, but also interrelated as three distinct patterns: (1) The categories criticising, explicating and envisioning appeared together. (2) The categories explicating, envisioning, committing to actions and taking action commonly appeared together. (3) The categories resisting, criticising, explicating, envisioning, and committing to actions appeared together. This thematic analysis is “less focused on language itself and more on its functions for the pursuit of joint intellectual activity” (Mercer, 2004, p.141).

Based on this analysis, we identified four snapshots that separately and together function as different empirical instantiations of the concepts of first stimulus (S1), second stimuli (S2) and transformative agency among the student teachers in this study (see Fig. 1). The snapshots are the result of deliberate, information-oriented selection intended to capture the emergent phenomenon. They are revelatory in the sense that they represent, not a data corpus per se, but a hitherto under-researched phenomenon (Yin, 2009) of what may be (trends) and what could be (visions of an ideal) (Schofield, 1993). Although not statistically generalizable, the snapshots serve as empirical carriers of deeper principles and “the extent to which findings from one study can be used as a guide to what might occur in another situation” (Kvale, 1996, p. 233) and a “fuzzy prediction […] which can serve as a guide to professional action” (Bassey, 2010, p. 5). The dialectics between S1 and S2 were

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### Table 3
Participants: Gender and subject distribution.

<table>
<thead>
<tr>
<th>Gender</th>
<th>2017 Cohort</th>
<th>Participants</th>
<th>Survey sub-sample</th>
<th>Focus group sub-sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overall cohort (N = 196)</td>
<td>SPOC sample (n = 139)</td>
<td>(n = 92)</td>
<td>(n = 12)</td>
</tr>
<tr>
<td>Male</td>
<td>32%</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
<td>68%</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
</tbody>
</table>

Note. SPOC = Small Private Online Course. *Subjects in the Master of Education (ME) programme: English, foreign languages, geography, history, mathematics, media, Norwegian, religion and ethics, science, social studies. **The remaining 8% is missing information about gender.
used as unit of analysis; we identified S1 situations and the S2 that the student teachers used to transform their practices.

Analysis of the questionnaire pertains to six closed questions and an open one from three of the five main themes, that directly addressed the patterns identified in the data. Theme C (PDC): To what degree do you have experience with planning teaching that includes digital technologies? (Question 5); To what degree do you find that school practice this term has contributed in developing your PDC? (Question 7), To what degree do you find that lectures this term have contributed in developing your PDC? (Question 8); To what degree do you find that the digital SPOC module this term has contributed in developing your PDC? (Question 11). Theme D (the SPOC): Is there anything (theme, assignment, method, approach) that you believe should not be part of the digital SPOC module? (Question 17). Theme E (Integration): To what degree do you find that the digital SPOC module is an integrated part of the pedagogy seminars? (Question 19); To what degree do you find that the digital SPOC module is an integrated part of the didactics seminars? (Question 20). Whereas all questions were analysed thematically, we also used SPSS software for analysis of the distribution of the questions. Means were calculated for each question for overall scores, and response distribution investigated. Taken together, the survey, the SPOC traces, and the focus groups make it possible to zoom in and out of the total data corpus in order to identify significant details and a broader landscape of transformative agency.

7. Findings: four empirical snapshots

The findings indicate three main patterns of student teachers’ transformative agency and Professional Digital Competence (PDC) development based on the Small Private Online Course (SPOC). These patterns occur in university seminars and in school practice, but often in combinations and rarely as separate and distinct entities. First, student teachers develop PDC through envisioning new models in university seminars (i.e. criticising, explicating and envisioning). Second, they develop PDC by taking consequential actions in university seminars and also in school practice (i.e. explicating, envisioning, committing to actions and taking actions). Third, they seek to develop PDC by committing to research-based actions in school practice (resisting, criticising, explicating, envisioning and committing to actions). Among the manifestations of student teachers’ transformative agency and PDC development we have visualised patterns in the form of four revelatory snapshots. These are thus not mere illustrations and were not selected because they demonstrate successful transformation or because they are representative of the total data corpus. However, they empirically show different instances of transformative agency enacted in problem situations and involving the use of cultural resources can be analytically examined in light of certain patterns and categories (see Table 4, below).

7.1. Snapshot 1: Developing PDC through envisioning new models in university seminars

The problem situation (S1) in the first snapshot involves the daunting task of integrating different knowledge types and the role of the SPOC. Integration can be seen as a potentially critical challenge or even conflict that has been sought resolved for years in teacher education (Hammerness & Klette, 2015). We observed a mixed response to survey questions that addressed the extent to which the SPOC integrates knowledge produced in university seminars. For Questions 19 and 20, a majority reported that the SPOC integrated knowledge from the pedagogy seminars (63%) or didactics seminars (53%) only to a limited extent or not at all. One focus group discussed this issue with regard to a pedagogy seminar where they designed a lesson plan together, involving information and communication technology (ICT) use to support their students’ learning processes in school. The student teachers integrated different knowledge types (subject specific, pedagogical, didactic and experiential) and justified their plan by referring to theory. In the following conversation, two student teachers elaborated on the usefulness of the SPOC (Fig. 2).

Here, Olivia acknowledges a conflict of motives; using digital resources to achieve learning outcomes or merely using digital resources for fun, obscuring the learning object(s). However, what Olivia refers to as “the opportunity to reflect” the purpose of including digital resources in the lesson design can be seen as a second stimulus (S2); such reflection might be seen as envisioning new models for future practices; reducing the risk and avoiding ‘pitfalls’ of experiencing digital tools merely as “fun”. Thus, Olivia demonstrates embryonic transformative agency as she acknowledges the importance of didactics and epistemic work when designing technology-based lessons.

Astrid is also envisioning new models. She operationalises Olivia’s emergent transformative agency by acknowledging the “opportunity to reflect” as a stimulus for envisioning new models for future teaching practices and by highlighting the collaborative aspect of the group assignment (S2) and its ability to integrate pedagogy, didactics, and the SPOC. This aspect becomes evident as
she talks in the plural (i.e., “we”). Hence, Astrid demonstrates more developed transformative agency both in acknowledging the value of integration and the collaborative efforts of designing technology-based lessons. Astrid also emphasises integration aspects of the SPOC. She acknowledges its role in explicating new possibilities and envisioning new models where “how you could use all three aspects” (pedagogy, subject didactics, the SPOC) and “the combination of all three” to capture the critical challenge of integrating knowledge types in teacher education. She even assesses the entire semester on a programme level, as she claims that the group assignment was “the most successful regarding the integration of pedagogy, subject didactics, and the [SPOC] really, almost throughout the entire semester”. In sum, Astrid invokes a series of S2.

In the SPOC, student teachers made similar observations of the combination of collaborative assignments in university seminars and individual efforts in the SPOC as crucial to developing their PDC. For example, Lise and Petter wrote about the importance of collaboration in the university seminars (Fig. 3).

Like Olivia and Astrid, Lise acknowledges the increased need to understand how theoretical knowledge can be productively used in teaching. She argues that the SPOC helped them find new ways of using digital tools, stating that “70% of our group assignment was from one place or another in Canvas” (explicating new possibilities). She addresses how the group assignment in the seminars helped her develop this understanding (envisioning new models) resulting in “an increased scope that I could not have gained through lectures about digital tools”. In her response, Lise demonstrates transformative agency as she acknowledges a series of S2 in terms of SPOC resources and seminar assignments influencing her PDC. Petter’s observation adds to these perspectives by emphasising yet another S2: the collaborative responses within
and across groups. Overall, this first snapshot demonstrates embryonic transformative agency in PDC development as the student teachers face an S1. They explicate new possibilities through the SPOC and envision integrative and collaborative models for their future teaching practices through the university seminars. They take on a persistent and critical challenge in teacher education: the integration of diverse knowledge types, domains and resources (Jenset et al., 2017; Lund & Eriksen, 2016) and demonstrate volitional action to respond to it.

7.2. Snapshot 2: Developing PDC by taking consequential actions in practice

The challenge of reticent learners is well known for teachers (Petress, 2001). Potentially productive class activities can easily be undermined when even resourceful learners, for a number of reasons, resort to silence. Teachers often respond to such critical challenges (S1) with frustration and uncertainty. During the focus groups, the student teachers mentioned TalkWall1 several times as a digital resource that supported face-to-face class discussions (i.e. a potential S2). They had been introduced to this artefact through the SPOC and university seminars in Norwegian didactics. The first utterance stems from a conversation where two student teachers were asked to reflect on whether they had succeeded in using ICT to support their students’ learning processes. Victoria reflects on how she in her school practice experienced the challenge of engaging students who were reluctant to speak in class, and how she solved the problem (Fig. 4), and Ole reflects on whether the ME programme had supported them in developing their PDC (Fig. 5).

In the first utterance, Victoria reflects on how to use TalkWall to facilitate class discussions, “giving them tools”. To explicate new possibilities, she turned to TalkWall as a digital resource that allowed her students to anonymously write contributions to the discussion (an S2). Victoria demonstrates transformative agency by taking consequential action; she changes the situation of reticent or inactive students by using a material artefact to break out of a potentially stifling situation.

In the Master of Education (ME) programme, university and school are seen as two mutually constitutive contexts for PDC development; however, student teachers may experience tensions between knowledge presented at university and school activities as they, respectively, draw on academic and experiential knowledge. This tension also represents an S1, although on a more systemic level than the one with reticent students. In the utterances above, both student teachers touch upon the link between school and university contexts. Victoria reflects on her consequential actions to change classroom practices and engage her students by successfully using a resource originally presented in university seminars. Ole reflects on how the tool was addressed in university seminars, valuing the discussions on how to use the tool in school practice and thus not only envisioning new models but engaging in consequential action. The introduction of digital resources in the SPOC module, their conceptualisation in university seminars and enactment in school practice represent a series of S2 as they bridge knowledge and PDC development across the SPOC module, university seminars and school practice. Victoria and Ole’s transformative agency is further mirrored in their digital traces, responding to a SPOC assignment (see Fig. 6).

Fig. 6 shows how Ole takes on the daunting task (S1) of building and sustaining his PDC. He acknowledges his prior insufficient PDC, while reporting that his PDC is now “stronger than before”. Ole demonstrates transformative agency as he recognises how the SPOC in combination with practice has made him more knowledgeable and skilled in mastering digital tools, making him more confident and motivated as a teacher. Ole further manifests his transformative agency by taking consequential action, stating that “I will continue to challenge myself to achieve the same progress further in my career”.

These findings from the focus groups and SPOC traces coincide with the survey Question 7, where almost half the student teachers (43%) reported that their practice had developed their PDC to some extent.

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![Fig. 4](image4.png)

**Fig. 4.** Student teacher Victoria’s reflection on classroom challenges (focus group response).

![Fig. 5](image5.png)

**Fig. 5.** Student teacher Ole’s reflection on PDC development (focus group response).
contexts, as an extended learning environment (Brevik, 2016, and how digitalisation might facilitate bridging between the two tives, curriculum, exams) and out of school (learners' life worlds) discontinuation of educational practices in school (learning objec-

7.3. Snapshot 3: Developing PDC by bridging in-school and out-of-
classroom practice) to changing the activity (see Fig. 1). It illustrates (in university seminars) to committing to speci
factions (through the SPOC) and envisioning new models (in university seminars) to committing to specific actions (in classroom practice) to changing the activity (see Fig. 1). It illustrates how the SPOC as an integrated part of the ME programme alleviates tensions between school practice and university seminars.

The third snapshot is linked to the dilemma of continuation or discontinuation of educational practices in school (learning objectives, curriculum, exams) and out of school (learners’ life worlds) and how digitalisation might facilitate bridging between the two contexts, as an extended learning environment (Brevik, 2016, 2019). One of the assignments in the SPOC module explicitly addressed this dilemma (S1) in English subject didactics of how to bridge the in- and out-of-school contexts (see Fig. 7) and provided links to relevant research as resources for the student teachers.

Fig. 7 shows how research indicates that neither students nor teachers bridge students’ use of English in digital technology outside school with their English use in school, thus emphasising the need to resolve this challenge (i.e. S1). As this type of S1 is increasingly common but challenging for teachers responsible for meeting the curriculum, they often find themselves perplexed and immobilised (Brevik, 2016, 2019; Sundqvist & Olin-Scheller, 2013; Wiig, 2019). Thus, the assignment was designed to encourage student teachers to enact transformative agency by addressing this lack of bridging and taking consequential actions in their English teaching. Fig. 8 illustrates how one student teacher, Julie, responds to the assignment.

Julie explains how she addressed the SPOC challenge of explicating new possibilities by talking to a student about his use of English outside school. She learned that he reads English while playing video games, and also reads the news and watches YouTube videos. She explains that she wants to explicate new possibilities in her teaching by envisioning new teaching models of linking the relevance of their personal experiences to the English curriculum (first S2); taking consequential actions to change her practice by designing a games-based English lesson, using Fallout (a dystopic role-playing game; second S2). Similarly, another student teacher, Petter, argues in the SPOC traces how he will keep himself updated on the digital lives of young learners, while connecting to a future-oriented stance of teaching (Fig. 9):

In line with such perspectives, Alice and Victoria explain in the focus group how the SPOC assignment encouraged them to take consequential actions in their PDC development. Based on the assignment in Fig. 7, the following utterances illustrate how this action materialized (Fig. 10).

Here, Alice is the one who brings up the SPOC assignment when challenged to elaborate on her transformative agency. She acknowledges a dilemma of ‘staying safe’ without engaging in game-based learning or daring to move beyond her comfort zone. By emphasising the need for assignments where they had to be more active, she demonstrates how the SPOC assignment challenges them to develop transformative agency. She is challenged to explicate new possibilities and envision new models, in which she expresses agentive potential; the word “use” is repeated followed by “we had to be more active”. Victoria goes beyond talking about the English assignment and envisions new models of bringing in gaming as an activity in the ME programme — even outside the SPOC module. Thus, Victoria actively invokes a series of S2 to operationalise educational potential in future practices.

Snapshot 3 demonstrates how student teachers develop practices by encountering a demanding dilemma (S1) and responds by explicating possibilities in the SPOC and bridging students’ English competence in and out of school. As in snapshot 2, the emphasis is now on student teachers’ agency and not merely by looking beyond their existing practices. The student teachers take consequential actions to develop their PDC, and demonstrate how this competence is enacted in practice when the corresponding resources (S2) are activated. Zooming out to the survey, Question 5 addressed the student teachers’ experiences with planning instruction that includes digital technologies. While almost half the student teachers (48%) confirmed that they had experience with this to a great or very great extent, a nearly equal proportion (52%) reported such experiences to a certain extent only or not at all. This variance serves as a general manifestation of the need to engage all student teachers in consequential actions such as designing educational environments that may alleviate initially problematic teaching situations.

7.4. Snapshot 4: Developing PDC by committing to research-based actions

Teacher education is expected and even required to be research
based, and very much so in Norway (Munthe & Rogne, 2015). This requires student teacher engagement of a type that has not always been fostered in TE. Thus, the final snapshot is devoted to how student teachers cope with the challenging task of utilising
research, making it relevant and incorporating it into their teaching practices.

The SPOC offered a module on, “ICT and Learning: What Does Research Say?” including hyperlinks to peer-reviewed journals. Student teachers were asked to search for research papers, summarise the methods, list findings and assess the relevance for classroom teaching and/or PDC development. Among the SPOC responses, some themes recurred (i.e., the value of Wikipedia, digital portfolios, multimodal texts and young learners’ digital literacy). Digital SPOC traces illustrate tensions and opportunities articulated by the student teachers when assessing the relevance of journal papers. For example, Nina offers a SPOC discussion of papers about gaming and learning (Fig. 11).

The excerpts in Fig. 11 invoke broad and fundamental issues.

Nina addresses the challenge of student teachers not being sufficiently involved “in their own learning development”. She explains new possibilities of using computer games as an S2 to address this problem. Similarly, Arne comments on a paper on multimodality, acknowledging student teachers’ need for personal development and digital citizenship; connecting pedagogy to formative and democratic issues raised by digital resources, using multimodality as a mediating concept. We see indications of how they link research to diverse themes and challenges—from digital citizenship to gamification—and broader societal issues. These are all aspects of the overarching S1, developing PDC and finding that research provides resources for an extended notion of PDC beyond instrumental skills, e.g. by connecting Freire’s concepts of literacy and liberation to multimodality. Thus, they point to a series of S2s
that might prove useful when encountering the challenging S1 of how to operationalise research in PDC development.

Zooming out to the survey, Question 17 offered insight into the usefulness of such research-based resources. When asked if any SPOC themes, assignments or approaches should be excluded, half of the student teachers said “no” (49%), whereas 5% criticised this assignment that required an agentive stance towards research. One student teacher revealed that he did not see how research related to teaching competence. Another responded that finding and summarising a research paper was “pointless”. These responses contrast with those in the digital traces and constitute a conflict of motives (typical of S1) and uncertainty on a collective level among the student teachers in this study.

As this conflict of motives is essential in transformative agency, we pursued the theme of research in the focus groups, and found that the student teachers had differing opinions on the usefulness of research-based resources. For example, while one student teacher claimed to really like these resources, increasing her insight into specific topics, Maria and Ole protested (Fig. 11):

These utterances demonstrate that conflict of interest exists among the student teachers. Maria and Ole express resistance to using research. For them, turning to research does not represent breaking out of a situation, they do not see the immediate relevance of research for their practices; neither for Maria’s “life world”, or for Ole’s students. Another concern is the temporal dimension: Maria suggests moving this assignment to the start of the SPOC for an overview, and Ole sees no connection between the assignment and the school practice, which take place simultaneously. However, taking up another student’s expression of “the teacher with the researcher’s eye”, he acknowledges the value of research-based resources, representing a potential S2 for breaking out of a constrained role and expanding into a research-based profession.

These utterances indicate two potential S2s: one at a structural level and one connected to professional identity and the research-informed teacher. Both amounts to breaking away from conflicting motives between immediate and more long-term PDC development. This snapshot reflects the rhythm and flow of collaboratively enacted transformative agency, which is riddled with tensions and uncertainty. Ole’s resistance resonates with the survey finding that 5% of the student teachers complained about the clash of priorities between research and obligations during practice placement. But we also see student teachers envisioning new models for future teaching practices (see Table 2), and moving towards new manifestations of transformative agency by conceptualising research in teacher education. However, actually committing to research-based actions remains unrealised on a collective level; the conflict of motives (S1) is not resolved.

8. Discussion

Through four revelatory snapshots we have sought to demonstrate how Professional Digital Competence (PDC) and transformative agency can alleviate or resolve problem situations and link school practice and university seminars, some of the persistent challenges identified in Avalos’s (2011) review of teacher professional development in Teaching and Teacher Education. This study examined how student teachers develop PDC involving transformative agency and how such agency can be identified, studied and fostered through a Small Private Online Course (SPOC). To examine the link between PDC development and transformative agency, we used the principle of double stimulation (Vygotsky, 1978) and analysed student teachers’ agentic endeavours involving how they use available resources (second stimuli, S2) to solve challenging situations or a conflict of motives (first stimulus,
It is possible to discern certain common denominators but also diverse manifestations of transformative agency across the snapshots. When we juxtapose them, we detect recurring features in the multifarious representations of transformative agency when student teachers face requirements for developing PDC. Table 4 provides an overview of the snapshots, the dialectics involved between S1 and S2, and how this movement amounts to instances of transformative agency in PDC development.

Table 4 shows that transformative agency comes in many combinations and degrees of enactment. Like Haapasaari et al. (2016), we see the six categories they developed more as a cluster than as a sequential progression in our empirical data—that is, they tend to appear in combinations and with blurred boundaries. Moreover, the snapshots add up to a display of challenges and competences that are not sufficiently covered in more generic, instrumental or non-transformative frameworks for digital competence. The snapshots go beyond the dimensions found in the three established pillars in the existing epistemic framework of PDC (Gudmundsdottir & Hatlevik, 2018), and we thus added a fourth pillar based on the theoretical framing of transformative agency, showing how this addition is necessary to enable (student) teachers to link challenges in school practice to university seminars.

The survey alone does not testify to agentive activity in the present study, but provides an instantiation of student teachers’ immediate reactions to the SPOC after completion. These responses were quite mixed; expressing both enthusiasm (the need for PDC) and resistance (rejecting the SPOC as irrelevant to their PDC development). Thus, on a collective level, the student teachers experienced a conflict of motives from which they could escape either by carrying on without engaging in PDC or acknowledging the need for PDC to expand beyond status quo.

The first common denominator in this study was found in the need for student teachers to expand their current PDC repertoire. However, both systemic and enactment levels are involved: some pointing to the competence involved in using software (i.e.,

Table 4: Instances of PDC development through transformative agency in the four snapshots.

<table>
<thead>
<tr>
<th>Snapshot</th>
<th>First stimulus (S1)</th>
<th>Second stimuli (S2)</th>
<th>Transformative agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>a) Critical challenge. How to integrate different knowledge types (subject specific, pedagogical, didactic and experiential)</td>
<td>The SPOC affording space for collaborative reflection. Assignments that afford new possibilities for teaching.</td>
<td>Embryonic. From recognising and acknowledging pitfalls and challenges to gradually envisaging and explicating new possibilities for professional development and enacting PDC.</td>
</tr>
<tr>
<td></td>
<td>b) Daunting task. How to build PDC.</td>
<td>Proprietary assignments. Hyperlinks to research resources. Conceptualising teacher with “researcher’s eye”.</td>
<td>Persistent S1, no quick fix or resolve.</td>
</tr>
<tr>
<td></td>
<td>c) Epistemic tensions between school and university contexts.</td>
<td></td>
<td>Transformative agency connected to transformed or expanded teacher role and professional enactment.</td>
</tr>
<tr>
<td>3</td>
<td>a) Dilemma. Discontinuation or bridging of in-school and out-of-school practices.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>a) Conflict of motives. Immediate, personal or strategic educational value of incorporating research dimensions in professional development and PDC.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TalkWall in Snapshot 2 and game-based learning in Snapshot 3, some pointing to specific- or didactic opportunities afforded by digitised resources (i.e., Snapshots 2—3) and some pointing to the transformation of knowledge and teacher roles (i.e., Snapshots 1 and 4) — all linking school practice and university seminars within the ME programme. The student teachers seem to operate on the horizon of their current PDC with an ambition to transcend status quo, demonstrating awareness of what a future oriented profession entails. This new practice is intimately linked to digitalisation and, thus, the need to continuously foster PDC in student teachers and educators in general.

A second observation across the snapshots is that transformative agency takes many forms and directions: unpredicted, unexpected, and also unresolved (as in Snapshot 4). There are simply too many variables at play; these are dependent not only on assignments and resources, but also on situations, circumstances and contexts (see Fig. 1). Hence, the interconnected transformative forces operating between S1 and S2 cannot be prescribed in detail, but TE designs can be conducive to student teachers taking control of their own PDC development. Although the snapshots do not explicitly address the collective level of transformative agency, the implications are that student teachers involved in such agency do not only prepare themselves for unexpected and complex situations. In a programme perspective, fostering transformative agency can also empower student teachers to collectively becoming co-designers and co-constructors of their own education.

Based on the four snapshots, there is a need to acknowledge how PDC will require student teachers (as well as teacher educators) to identify challenging situations (S1) both in university seminars and in school practice and, in their teaching designs, make a series of S2s available to transform the S1 into an opportunity for learning and development — envisioning new models, committing to and taking consequential actions to developing their PDC.

Throughout the paper, we have argued for and analysed processes of double stimulation as a suitable lens for this endeavour. However, we have had to contend with some limitations. One is that this study has not ventured into the representativeness of the patterns and snapshots analysed. The data corpus holds empirical carriers of patterns and agencies that do not necessarily qualify as transformative. We acknowledge the value of presenting a more comprehensive picture. However, it has been beyond the scope and aims of this study to examine the relative representation of such patterns by identifying and counting instances to map the complete corpus. Also, we acknowledge the need for additional research on how the links between PDC, double stimulation and transformative agency can be further operationalised in TE programmes, or in any kind of learning situation where status quo is deemed insufficient.

9. Conclusion

This study showed how a Small Private Online Course (SPOC) component, aiming to foster Professional Digital Competence (PDC) in a master’s programme for teacher education, was perceived, responded to and transformed into commitment, activities and practices by student teachers. Using Vygotsky’s (1978) double stimulation principle, we conceptualised and analysed the dynamics and dialectics between problem situations in teacher education (first stimulus, S1) and available resources with the potential to transform the challenges into productive learning opportunities (second stimuli, S2). We found that student teachers actively sought to resolve demanding situations by going beyond their current PDC through engaging in diverse forms of transformative agency.

The contributions of this paper are threefold. First, on an empirical level, we have demonstrated how transformative agency is enacted to develop PDC in teacher education when aiming to link school practices and university seminars through a SPOC component. Second, on a methodological level, we identified the applicability of the indicators in Haapasaaari et al.’s (2016) typology to teacher education research. We also continued the Vygotskian project of studying development and unrealised potential; applying the principles of double stimulation and transformative agency and used the dialectics between S1 and S2 as our unit of analysis while drawing on three mutually constitutive data sources among student teachers (digital traces, survey and focus groups). Third, our conceptual contribution is the development of a fourth PDC pillar; namely transformative digital agency. Using the analytical framework of transformative agency, this paper provides evidence of how student teachers actively respond to challenging situations during school practice — by linking these to discussions in university seminars and available SPOC resources — that potentially transform the original situations through PDC development.

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