Artikkel 4

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Teacher educators' and teacher students' perceptions of working with digital technologies: Similarities and differences of attitudes, skills and practice across a generational change.

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Abstract

In the majority of EU countries, digital competence (DC) is written into formal national guidelines for degree requirements in teacher education. Norway is one of the countries that has been exposed to the strongest top-down implementation of ICT in education. The Norwegian plans have emphasised DC as one of the basic competencies that teacher educators and pre-service teacher students are required to focus on during education. However, despite the national effort, it seems that practitioners in the education system are not working in line with the given policy, and it is a gap between the micro and the macro level. The pervasive change in the Norwegian curriculum call for a closer exploration.

The gap between the micro and macro level is often explained by practitioners' deficiency and/or lack of interest. To better understand these relations, and to help us predict the future use of educational technology in our schools, we have conducted a quantitative study of teacher educators and their students in Northern Norway (N = 112). It appears from the analysis that among the staff the professional attitudes have a stronger impact than digital competence regarding the extent of the educational use of digital tools, while digital competence has a stronger influence than attitudes among the students. These results are interpret through Argyris and Schön's *Theory of Action*.

Keywords: Teacher education, digital attitude, digital literacy, teachers' professional digital competence

Introduction

For many years, information and communication technology (ICT) in education has been an important area of focus. In the majority of EU countries, the introduction of ICT in education has been written into formal national guidelines for degree requirements for teacher education as national policy. The United States federal government, and the main teacher education accreditation organizations in US, also push for the inclusion of technology in teacher education across the curriculum (Nelson et al. 2019).

Some countries has chosen a very offensive strategy in implementing this policy, and the ongoing changes may be of special interest to study. In Norway, the modernising of school curricula have resulted in several pervasive changes in pre-service teacher education, where digital competence (DC) was officially formulated in 2005 as the fifth basic skill for all subjects at all levels of school. Digital skills has a status equal to oral skills, reading, writing and numeracy. The government White Paper No. 11 (Ministry of Education and Research [MER], 2008) has emphasised DC as one of the basic competencies that teacher educators and teacher students are required to focus on during their initial teacher education. This change in both the school curriculum and in the general plan for initial teacher education has in effect changed the underlying premise for teaching and learning in Norwegian teacher education programmes (Krumsvik, 2014). This article studies the impact of such a pervasive strategy, by presenting an exploration of teacher educators and their students at a Norwegian university (UiT, the Arctic University of Norway).

Does practice within *teacher education* correspond with the intentions of the national policy? Several international studies show that teachers integrate technology insufficiently in their educational practices (Enochsson & Rizza, 2009; Tondeur et al., 2012; Tondeur, van Braak, Siddiq, & Scherer, 2016). ICT has not changed education as much as anticipated by policy-makers. Several Norwegian studies have investigated how DC is integrated into teacher education (Instefjord & Munthe, 2016; Krumsvik, 2011; Lund, Furberg, Bakken, & Engelien, 2014). These studies report insufficient DC among teacher educators and that the use of digital tools in teacher education is less frequent and less developed than in schools. Insufficient skills or interest among teacher educators may be a main obstacle for the integration of digital tools. In Monitor School 2013, institutions of teacher education are described as having limited professional profiles in the digital domain (Hatlevik, Egeberg, Gudmundsdóttir, Loftsgarden, & Loi, 2013, p. 32). What is repeatedly observed in such surveys is that digital tools are not used satisfactorily, compared to the formal intentions (Enochsson & Rizza, 2009). A further conclusion to be drawn from this is that the academic staff does not have sufficient DC. Lack of DC may be *one* explanation of the difference between the management documents and educational practice, but are there also differences based on pedagogical theories, opinions and experiences?

There has also been extensive research on the use of digital tools in the *general education* in Norway, from primary to higher education. Looking at these surveys, we seem to move very slowly towards the described intentions regarding the use of digital tools. Nevertheless, a great gap between the political intentions and what is done in practise in higher education still exists (Tømte & Olsen, 2013;

Ørnes, Wilhelmsen, Breivik, & Solstad, 2011). Much of the mentioned research is focused on the fact that such a gap between political intentions and educational practise of higher education exists. The Norwegian University Monitor, Digital State 2011, concludes that the use of digital tools mainly supports traditional teaching, and there is a potential for better utilising the opportunities provided by the technology (Ørnes et al., 2011, p. 199). It is explained in the same report that professionals emphasise professional reasons for why they use digital tools in teaching, but professional reasons for *not* using digital tools are hardly discussed in the surveys.

For example, some recent research shows that students who often use computers or smartphones have a tendency to do worse when compared with students who make less use of such tools in educational contexts (Beland & Murphy, 2015; Carter, Greenberg, & Walker, 2016; Elstad, 2016b; OECD, 2010). Mueller & Oppenheimer (2014) conducted a study in which they concluded that the use of a laptop negatively affected the students' test results. This study focused on the students' use of a laptop instead of a pen when taking notes during lectures. They raise the question whether using a laptop in classrooms does more harm than good. They argue that note taking by hand calls for other cognitive processes than writing on a laptop. Elstad (2016b) writes that the general formational effect of education provides the requisite cognitive qualities for understanding. One can write faster on a laptop, and take more notes. 'Although more notes are beneficial, at least to a point, if the notes are taken indiscriminately or by mindlessly transcribing content, as is more likely the case on a laptop than when notes are taken longhand, the benefit disappears' (Mueller & Oppenheimer, 2014, p. 1166). To write by hand is slower and one cannot take verbatim notes in the same way as with a laptop. Instead, students listen, digest and summarise so that they can succinctly capture the essence of the information. 'Thus, taking notes by hand forces the brain to engage in some heavy "mental lifting," and these efforts foster comprehension and retention' (May, 2014). As May points out, 'even when technology allows us to do more in less time, it does not always foster learning'.

On the other hand, a review of 29 empirical studies shows that training for children by technology-mediated writing contributed to increased learning and motivation (Williams & Beam, 2019). Technology-mediated writing proved to be particularly effective for children who struggled with writing. The difference between the findings of Mueller and Oppenheimer (2014) and Williams and Beam (2019) underlines how important it is that the use of digital technology is targeted and that critical pedagogical assessments are paramount in the different learning situations. Technology often change the nature and meaning of tasks and activities, as well as creating new educational practices.

Having this as a background, the present study aims to contribute to the ongoing research by applying the 'Theory of Action' approach by Argyris and Schön (1978) for a closer inspection of the teacher education as performed at UiT in Northern Norway. This study is a contribution to broadening the understanding of how the technological revolution and its impact on education can be understood from the practitioner's point of view, and is part of a research project aimed to elaborate further the understanding of the complexity behind the established mismatch between policies and the use of digital technology in teacher education. Towards that end, we have asked: *How do teacher educators and teacher students perceive the professional use of digital tools?*

We have conducted a comparative study between teacher educators in Norway and teacher students in the fourth year of their master's program. Teacher education is of special interest as it plays a double role in relation to DC: it develops both teacher students' professional skills *and* their expertise in facilitating pupils' learning. A teacher educator who uses digital tools for the enhancement of the learning process of the students also shows students at the same time how digital tools can be used in primary and secondary education (Drent & Meelissen, 2008; Engen, Giæver, & Mifsud, 2015). Moreover, creating good-quality teacher education in the digital arena has many facets, which take into account the needs of the student, school and current curricula to prepare students for their future work as teachers.

Theoretical framework

Our study is based on the Theory of Action by Argyris and Schön (1978), an approach that begins by defining a concept of human beings as designers of action (Argyris, 1992). Theory of Action explains the 'mechanisms' by which we link our thoughts with our actions. The theory is a theoretical framework, which offers an analytical distinction between 'espoused theory' and 'theory in use' (Argyris & Schön, 1996).). This was used to structure and describe the data. Espoused theory is defined as being the theory of action that is framed to explain or justify a given pattern of activity. In other words, espoused theory can be understood as the individual's or the organisation's *attitudes* towards practices (Argyris & Schön, 1996). Theory in use is defined as the theory of action that is implicit in the performance of that pattern of activity, in other words, practical action of *competence*. As described by Argyris and Schön (1996, p. 14), organisational theory in use may be tacit rather than explicit. Tacit theories in use do not necessarily match the organisation's espoused theory. An organisation's formal documents, such as policy statements or work descriptions, will often contain espoused theories of action inconsistent with the organisation's actual pattern of activity (Argyris & Schön, 1996). According to Argyris (1992, p. 216), these general theories of action determine all

deliberate human behaviour. The mechanisms can occur both consciously and subconsciously; it may therefore be challenging to determine the discrepancy between your espoused theory and theory in use.

A central and comprehensive theme in Argyris and Schön's learning theory is the link between learning, change and resistance to change. It outlines two models – Model I (single-loop learning processes) and Model II (double-loop learning processes) – to highlight the potential for organisational learning.

Single-loop learning processes involve following the routines and some sort of a pre-set plan – which is both less risky for the individual and the organisation and affords greater control. It may also be characterised as a technical way of thinking. Single-loop learning seems to be present when goals, values, frameworks and strategies are taken for granted, with only minor updates. The emphasis is on techniques and making such more efficient. Any reflection is directed towards making the strategy more effective.

Double-loop learning processes, in contrast, are more creative and reflexive, and involve the consideration of notions about what is good. Reflection here is more fundamental: 1. The basic assumptions behind ideas or policies are confronted. 2. Hypotheses are publicly tested. 3. Processes are challenging, not self-seeking and have organisational goals. The governing aim includes valid information and internal commitment. Double-loop learning involves questioning the role of the framing and learning systems that underlie actual goals and strategies. (See Argyris and Schön, 1978; 1996; and Argyris, 1992.)

Theory in use.

To get insight into the respondents' theories in use, both academic staff and students were asked about the extent of their use of different digital technologies when teaching. A theoretical approach was also applied to construct statements for the questionnaire based on the term 'digital competence'. This term was operationalised by using definitions by Tømte and Olsen (2013) and Lund et al. (2014). In accordance with their definitions, the focus was on three defined aspects of DC: pedagogic and didactic understanding, subject-specific understanding and technological understanding. This definition of DC was chosen because recent literature is generally in agreement regarding this categorical understanding of DC (Lund et al., 2014; Tømte & Olsen, 2013). 'Digital literacy' is also a term in common use, as there are many overlapping and complex terms in this field of research (Beck & Øgrim, 2009; Instefjord & Munthe, 2016; Thorvaldsen, Egeberg, Pettersen, & Vavik, 2011). It is

hard to translate ‘literacy’ to Norwegian. The surveys are therefore based on the term digital competence (digital kompetanse), to secure the comparative element in the study.

Espoused theory

To get an understanding of teacher educator and student attitudes (their espoused theories), statements were prepared, based on the Organisation for Economic Cooperation and Development (OECD) report ‘Connected Minds: Technology and Today’s Learners’ (2012) and its description of the field’s existing attitudes towards technology. In the report, the field is characterised by a continuum, from being technology averse to being technology positive. To be included within this span of attitudes, statements were prepared to identify the respondents’ own motivations for using digital tools, the respondents’ attitudes towards digital tools’ position in the public arena and their attitudes towards the use of digital tools in teaching.

Method, Design and participants

The study was designed as a cross-sectional study starting with the academic staff at the Department of Education at UiT in spring 2015, with a follow up of their students three years later to be able to observe the influence of the educational process.

We conducted the survey of the academic staff at all teacher education programs at the Department of Education at the University of Tromsø. This includes preschool teacher education, integrated master’s in teacher education 1–7, integrated master’s in teacher education 5–10, integrated master’s in teacher education 8–13 and practical pedagogical education. Teachers from UiT presented a selection of 80 participants, for which 67 participants responded to a questionnaire survey. This implies a response rate of 83.8%. We eliminated all who were mainly administrative staff, and employees who had less than 30% teaching in the past year. Data included in this survey are associated with the remaining 64 respondents. This group of respondents constitutes the target group, namely professional staff at teacher education, with 30% education or more. The student group included all fourth year master’s students in teacher education 1–7 (UiT, 2016a), and 5–10 (UiT, 2016b), with response from 48 of 61. This implies a response rate of 78.7%.

There were 57.8% females among the staff and 66.7% among the students. The majority of the academic staff were above 45 years of age, while the majority of the students were 25 years or less (range 23–31 years). The young age of the students qualifies them to belong to the generation of ‘digital natives’ (Prensky, 2001).

Instruments and statistical analysis

The questionnaire was developed based on Argyris and Schön's theory of action. Data were collected from teachers' and students' self-reports. A 5-point Likert scale was used for most of the questions with the following scoring options: 1 = strongly disagree, 2 = moderately disagree, 3 = neutral, 4 = moderately agree and 5 = strongly agree; or 1 = never, 2 = rarely, 3 = occasionally, 4 = often and 5 = extensively. The questionnaire had 38 items. Some of the items were collapsed into three multi-item constructs, as shown below, while others remained as single items. Some items had a reversed scale, denoted by REV. The survey involves three main constructs: *Digital Competence*, *Professional Attitude* and *Professional Applications of Tools*. The two constructs of Digital Competence and Professional Attitude were based on Likert-scaled statements, and the Professional Application of Tools was based on the reported frequency of use of 16 digital technologies and work methods of the participants in their own teaching in the past year. The constructs were each based on questionnaire items, as follows:

Digital Competence:

- I am familiar with digital tools that can help diversify teaching.
- I am, in general, confident when using digital tools.
- I find it easy to become familiar with new digital tools.
- I can use digital tools that are appropriate for the aspects of the subjects I am teaching.
- It is difficult to use digital tools as an educational resource within my subject. REV.

Professional Attitude:

- When I use digital tools in my teaching, I find it adds value.
- The use of digital tools is essential for good teaching.
- Society's expectations for the impact of digital tools are exaggerated. REV.
- Expectations related to the use of digital tools in teaching frustrate me. REV.
- In academic debates at our university, the expectations of the impact of digital tools are exaggerated. REV.

Professional Application of Tools:

- Digital tools for testing with multiple choice questions
- Moodle or Fronter (each university's learning management system)
- Digital tools for presentation (like PowerPoint or Prezi)
- Word processor
- Spreadsheets (like Excel)
- Use of video

- Production of film/video/animation
- Online discussions
- Online meetings (like Lync, Adobe Connect or Skype)
- Production of Wiki (website that allows collaborative modification)
- Screen capture (like Camtasia or Mediasite)
- Programs for scientific analyses
- Student response systems (online questions answered by phone or computers, like Kahoot! or Socrative)
- Tools for collaborative writing (like Google Docs)
- Social media (like Facebook or Twitter)
- The Internet as a source of knowledge

The study was carried out digitally using the commercial online survey tool 'Questback'. The questionnaire is a slightly modified version of the one used in our previous study (Madsen, Thorvaldsen, & Archard, 2018).

The statistical analysis of the quantitative data was carried out by SPSS Version 24 using descriptive statistics and t-tests for comparison of two independent groups. We computed Cronbach's alpha for all constructs as a measure of internal consistency and analysis of reliability. The Cronbach's alpha measures yielded a value of alpha of 0.75 for Digital Competence, 0.66 for Professional Attitude, and 0.71 for Professional Application of Tools. This described the extent to which all the items in the construct measured the same concept. This evaluation of the reliability of data and internal consistency in the three constructs created a basis for further analyses. We investigated differences between the two groups by using the Student's t-test. Cohen's effect size (d-value) was applied in order to study differences between the groups. This term calculates the difference between two groups measured in standard deviations and is estimated as the difference between the groups' averages divided by the average standard deviation for these two groups. King, Rosopa, and Minium (2011, p. 246) refer to Cohen, who suggested that a power size of 0.2 represents a small effect, while a coefficient of 0.5 is considered a moderate effect and 0.8 is considered to be a major effect. In Tables 1 and 2 we first present the descriptive statistics describing the results for each individual question separately for the two groups, and then the results are shown from comparative tests between the groups as well as the effect size.

Results

When looking at the multi-item constructs in Table 1, the staff report somewhat higher DC than students do, but the difference is not significant. The staff scores an average of 3.91, and the students 3.74. It is natural that teacher educators are somewhat more familiar with digital learning tools in education and that they are more confident in the usage. This is about accumulated technological and pedagogical experience. This also means that they do not think it is as difficult as the students to use digital tools as an educational resource in teaching school topics (p-value = 0.06). What is more surprising is that the students score lower on digital competence in all other areas, apart from a somewhat higher score in using digital technology that is appropriate for the subject they teach.

In terms of attitudes, students are less critical than teacher educators (p-value = 0.056). But on average, both groups are reasonably neutral in terms of whether they consider digital technology important for good teaching. At a personal level, both groups on average express themselves as positive about their own use of digital technology adding value to their teaching. When asked if there is an exaggerated belief in digital technology in teaching, academic staff respond that from both a societal and a university perspective there exists an exaggerated belief in the effects of digital technology. Of the staff respondents, only 15.6% disagreed with the statement ‘Society's expectations of the impact of digital tools are exaggerated’, while 57.8% of the respondents moderately or strongly agreed with the statement. Therefore, societal expectations are not necessarily in line with teacher educators’ espoused theories. Most of the teacher educators did not agree with the perceived attitudes in the public domain.

When the participants were asked to agree or disagree with the statement regarding whether or not expectations concerning the impact of digital tools in academic debates at the university are exaggerated, the scores between staff and students were significantly different (p-value = 0.042). In the staff part of the study, the participants did not express confidence towards their colleagues’ assessment of digital tools, but in the students’ part of the study the participants’ understanding of fellow students’ attitudes towards digital tools were more in line with the participants’ own attitudes. On the other hand, both staff and students slightly disagree that this causes frustration.

Table 1: Self-perceived results from staff and students. The table also shows p-values (t-test) and effect size (Cohen's d).

Variables list	**Scale**	**Staff Mean (SD)**	**Students Mean (SD)**	**p-value**	**Effect size**
Digital Competence (c)	1–5	3.91 (.76)	3.74 (.66)	.20	-.25
I am familiar with digital tools that can help diversify teaching.	1, 2, 3, 4, 5	4.02 (1.00)	3.85 (1.03)	.41	-.16
I am, in general, confident when using digital tools.	--- "---	3.95 (1.02)	3.79 (.97)	.40	-.16
I find it easy to become familiar with new digital tools	--- "---	3.53 (1.13)	3.23 (1.13)	.16	-.27
I can use digital tools that are appropriate for the aspects of the subjects I am teaching.	--- " ---	3.89 (1.06)	3.98 (.81)	.63	.10
It is difficult to use digital tools as an educational resource within my subject.	--- " ---	1.81 (.97)	2.17 (.98)	.06	.35
Prof. Attitude (c)	1–5	3.00 (.73)	3.23 (.54)	.056	.38
When I use digital tools in my teaching, I find it adds value.	1, 2, 3, 4, 5	3.88 (.93)	4.04 (.74)	.31	.20
The use of digital tools is essential for good **teaching.**	--- " ---	2.44 (1.21)	2.67 (1.10)	.30	.20
Society's expectations of the impact of digital tools are exaggerated.	--- " ---	3.53 (1.08)	3.06 (.89)	.013*	-.48
Expectations related to the use of digital tools in teaching frustrate me.	--- " ---	2.38 (1.06)	2.40 (1.10)	.92	.02
In academic debates at our university, the expectations of the impact of digital tools are exaggerated.	--- " ---	3.42 (.94)	3.06 (.89)	.042*	-.39

N = 112.

(c) Constructs combining the single variables below.* Significant at the 0.05 level (2-tailed).

Table 2: Self-perceived use of digital tools from staff and students. The table also shows p-values (t-test) and effect size (Cohen's d)

Variables list	**Scale**	**Staff Mean (SD)**	**Students Mean (SD)**	**p-value**	**Effect size**
Prof. Application of Tools (c)	1–5	2.59 (.54)	2.88 (.41)	.002**	.60
I often use digital tools in my own teaching.	1, 2, 3, 4, 5	3.95 (1.09)	4.50 (.77)	.002**	.59
I mainly use digital tools in my **teaching because it is expected by others.**	--- " ---	1.88 (1.06)	2.31 (.99)	.029*	.43
I have experienced that the use of technology in teaching has been disruptive for the expected outcomes.	--- " ---	2.83 (1.12)	2.98 (1.06)	.47	.14

N = 112. (c) Construct combining 16 variables on digital tools/work methods applied in teaching during the past year. * Significant at the 0.05 level (2-tailed). ** Significant at the 0.01 level (2-tailed).

Table 2 shows the results for the application of digital tools and work methods in teaching during the past year. The construct Prof. Application of Tools consists of 16 items, and six of the items show a significantly higher use (p-value < 0.05) in the student group (Multiple Choice, Production of Video, Production of Wikis, Student Response System, Collaborative Writing like Google Docs and Internet as a source of knowledge). The staff group scored significantly higher in three items (Moodle/Fronter LMS, digital presentations and online meetings). The construct Prof. Application of Tools has a significantly higher score for the students (p-value = 0.002), and they agree to a larger extent than the staff that digital tools are used because it is expected by others (p-value = 0.029). The different scores in application may be natural as the staff relates mainly to teaching in higher education, and the students relate more to education in primary and secondary school.

Table 3: Correlations for each group separately.

	Digital Competence (c)	**Prof. Attitude (c)**
Prof. Application of Tools (c)	.327 ** (Staff)	.452 *** (Staff)
	.428** (Students)	.327 * (Students)

N = 112. (c) Construct combining single variables. * Significant at the 0.05 level (2-tailed). ** Significant at the 0.01 level (2-tailed). *** Significant at the 0.001 level (2-tailed).

Correlation analyses conducted for each group (Table 3) reveal interesting differences between them. Among the staff the Prof. Application of Tools variable is strongly correlated with Prof. Attitude (r = .452), and less with Digital Competence (r = .337), but in the student group it is the other way around.

Table 4: Regression analysis to predict Prof. Application of Tools.

Variable list	**Staff**		**Students**	
	Beta (standardised)	p-value	Beta (standardised)	p-value
Digital Competence	.175	.16	.371	.008**
Prof. Attitude	.382	.003**	.239	.08

** Significant at the 0.01 level (2-tailed).

When we try to predict the professional application of digital tools (Prof. Application of Tools) among the students, the best predictor is Digital Competence (Beta = .371, p-value = .008), while the best predictor for staff is Prof. Attitude (Beta = .382, p-value = .003). It appears from this analysis that the influence and contribution of digital practice is carried out quite differently within the two groups. Among the academic staff, the professional use or application of digital tools is dominated by professional attitude, while among the student group it is dominated by digital competence. At the same time, the digital competence is somewhat lower in the student group, but the professional application of digital tools is significantly higher. Adjusted R-square for the multiple regression model in Table 4 is .20 for both models, which tells us that 20% of variation in the output variable (Prof. Application of Tools) can be explained by the predictors in the model.

Discussion

As mentioned earlier, teacher education is often described as being one step behind primary and secondary schools in the use of digital tools, and confidence in teacher education to handle this gap has been weak (Haugsbakk, 2013; Selwyn, 2016). Elstad (2016a) claims that young people have digital capabilities and describes that some researchers regard youth as digital natives, in contrast to teachers who are disrespectfully described as ‘digital slow-coaches’ (Elstad, 2006) or ‘digital immigrants’ (Prensky, 2001). Technology in itself is seen as a catalyst for educational change, and technology as a symbol for change is often understood as something positive, as investments in technology will support development in society. Haugsbakk (2013) argues that this reflects an instrumental perspective on technology. In addition, there also exists indications that the use of education technology may not lead to better learning outcomes or increased efficiency (Elstad, 2016a, 2016b; Selwyn, 2016).

Only 10 out of 64 respondents from the academic staff disagree moderately or strongly with the statement that '*Society's expectations of the impact of digital tools are exaggerated*', while 37 of the employees agree moderately or strongly with the statement. Thus, most people do not agree with the signals that are communicated in the public domain. What is more surprising is that the same trend is applicable when asked if there are excessive expectations as to the effect of digital tools in the academic debates at the university. On this question, only 8 out of 64 respondents from staff answer that they somewhat or completely disagree that the UiT's academic debates have exaggerated expectations for the effects of digital tools. However, 32 out of 64 agree that the academic debates at UiT are characterised by too high expectations for the effect of digital tools.

These figures represent a bias, characterised by a dual culture, one in which employees have an attitude towards digital tools that indicate that the majority within the teacher training staff do not consider digital tools as essential for good teaching. This suggests an inner academic culture that does not correspond with the public culture and general university policies, or that the employees' attitudes are quite diverse, and possibly a fragmented and inconsistent group.

The fact that most of the academic staff at the Department of Education at UiT think that the academic debate is characterised by too much confidence in digital tools can indicate several things. For example: In debates, employees express more optimism towards digital tools in teaching than they really mean. It may concern political correctness and a desire not to go against the flow. Another explanation might be that those who dominate the debates are the technologically positive ones, while those who are critical choose not to express themselves.

The figures from the students are in line with the public culture and the expressed university policies. One interpretation may be that the teacher students do not have the amount of experience the teacher staff has in terms of experiencing the limitations and negative effects of digital technology. The students could be more optimistic and influenced by how digital technology is introduced, and not so much by how it is experienced, as they have limited experienced compared to the teacher educators. Experience and legitimacy through a long career could make it easier to go against the flow and to have independent attitudes within educational policy making when in disagreement. This is supported by some of the differences in the answers to the questions about whether they use digital technology because it is expected by others (Table 3), where students agree significantly more than the staff (p-value = .029, with effect size d = .43).

Farjon et al. (2019) conducted a study at a large Dutch university that examined to what extent teacher students integrated digital technology in their own practice. In this study, they found that

attitudes had the greatest effect on the students' use of digital technology into their own practice, measured against both experience, DC and access to digital tools. However, only pre-service teachers at the very start of their initial teacher education program were included in the Dutch study, while our students are in their fourth year.

In our regression analysis, we found that the contribution to digital practice is carried out quite differently for the academic staff and the student group. For the staff, the digital practice is dominated by a professional attitude, while in the student group it is dominated by digital competence. Argyris and Schön's *Theory of Action* may give us a relevant framework to understand this observation on a deeper conceptual level. A central theme in their learning theory is the link between learning, change and resistance to change, where the theory emphasises single-loop and double-loop learning processes. Single-loop learning processes mainly involve following pre-set plans, while double-loop learning processes are more fundamental and include consideration where ideas or policies are challenged.

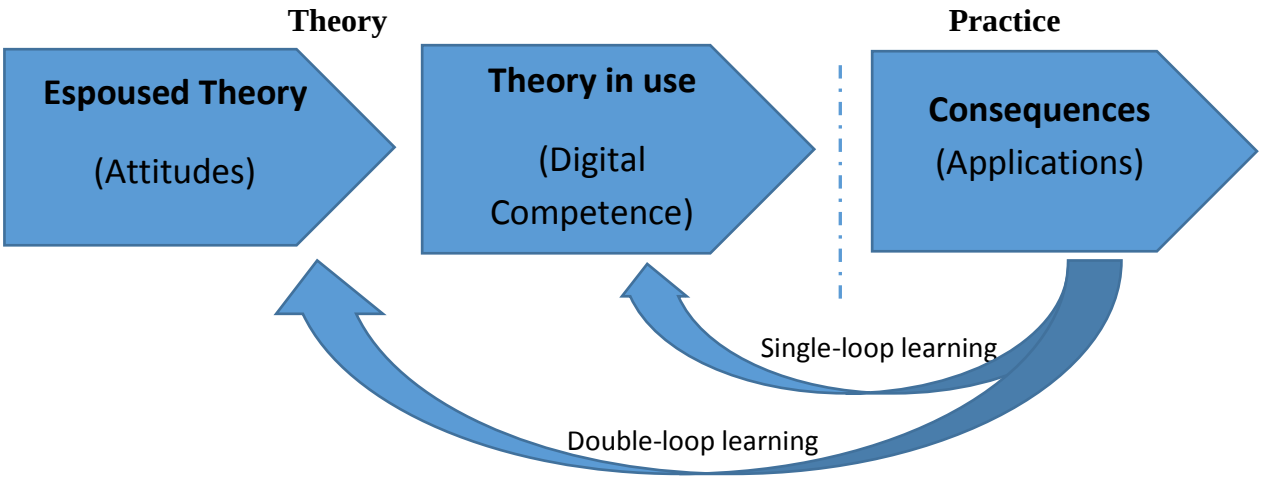

Figure 1. Single-loop and double-loop learning processes. Adapted from Argyris and Schön, (1978).

Based on our previous analysis we suggest that that the students' didactical perspective may be characterised as mainly a *single-loop learning* process based on *digital competence*, while the academic staff in addition is involved in a *double-loop* learning process where also their professional *attitudes* are involved. The interactions are illustrated in Figure 1. Single-loop learning is effective and rational on the basic didactical level, while double-loop models are more open to discussions and adaptations and provide more opportunities for choice.

One example of this is described in Elstad (2016c), where a pioneer Norwegian school had committed itself to becoming a showcase, 'the school of the future' with extensive use of ICT, co-operative learning, work in an interdisciplinary manner and project orientation. Their aim was to be

Europe's number one school regarding the use of portable or mobile computer technology. Thirty to thirty-five percent of the teachers demonstrated enthusiasm and 10% were reluctant, while the majority had a wait-and-see attitude. Two years after, most of the positive-minded teachers had changed their view of the need for managerial intervention and put forward a demand to the leader. Control issues were the subject of conflict as the pupils took advantage of the opportunities that portable computers gave in terms of non-academic activity. Five years passed before the practitioners were heard and strategy were changed to reduce the problem. With experience came the realisation that doing more of the same was not working regards the pupils' learning, and the single-loop learning resulted in a mismatch between educational goals and achieved goals. When entering a double-loop learning process, and looking critically into the preconditions for the challenges at hand, the teachers demanded the leader to change the preconditions by using a joint systemic strategy to reduce the problems of non-academic activity.

According to Elstad (2016c), political expectations regarding the modernisation of the schooling system using ICT, and the allocation of funds in accordance with this policy, created agendas not compatible with the constraints and operational features within education. If one is presented with an ideology and this is guiding your practice, the students are more likely to act based on single-loop learning. With experience comes a greater opportunity to evaluate not only policy, but also how policy affects practice. This knowledge is a prerequisite for making a critical analysis of teaching and to act based on double-loop learning.

In double-loop learning processes, an educational organisation can handle the basic challenges related to the application of technology. It is not about being one step behind, but about taking steps aside to gain a deeper perspective. Successful teaching is not only about finding the right technology, but also about adding values, norms and attitudes that reside within the academic staff at teacher training organisations. Langset, Jacobsen, and Haugsbakken (2018) found that contrary to top-down initiatives, a more horizontal approach supports the pedagogical variation and tailor-made solutions that are necessary in large heterogeneous organisations. The project conducted by Langset et al. (2018) focused on local initiative and participation, as well as the feeling of autonomy that the participants experienced. The participants were free to explore new applications at their own pace and to decide which new technologies to implement and how to use them in their courses. The findings in their study showed that these were important factors supporting the argument for horizontal approaches instead of top-down implementation.

We think Argyris and Schön's differentiation between single-loop and double-loop learning in their *Theory of Action* may contribute to a deeper acknowledgement of the fundamental challenges that still have to settle in the domain of educational technology. Both processes exist at the same time, but with different actors. Both actors are important, and may make valuable contributions to refining the learning process.

Concluding remarks

It is too easy to hold the teacher education as the main responsible factor for the lack of successful integration of digital tools into learning practices. The limited digital success suggests that these efforts to update and improve teacher education might not be a quick way forward to the closing of the observed gap. The digital tools themselves, and their actual value in various learning environments, seem to need a deeper examination as the value of technology should not be taken for granted in the domain of education. Technology integration in the pedagogical landscape is complicated.

We asked the question on how teacher educators and teacher students perceive the professional use of digital tools. In this study, we made several observations. Norwegian teacher trainers and their master's students both report similar levels of DC, but the teacher trainers have a more critical attitude than their student towards the application of digital technology in education. Extended experience may explain why the academic staff have a different viewpoint on the pedagogical use of digital tools. Mere skills and knowledge are not enough to integrate technology successfully (Mouza et al., 2014). In a recent analysis of curriculum documents for teacher education in Norway, Instefjord and Munthe (2016) point out that digital competence and use of digital technology are not integrated to a satisfactory degree at the subject-specific level, and this is still work in progress. Plans will need tight coupling based on experience to have successful learning impact. Subject based didactics should to a greater extent set the terms for technology in education, not the other way around.

Many EU governments have been active to influence and reform both the school system and teacher education. The Norwegian implementation plan positions digital technology in teaching in a way that activates resistance and creates contrasts between teacher educators' experiences and work-related requirements for implementation. This paper presents findings regarding how this affect teacher educators' attitudes towards their professional position. The political enthusiasm that has prevailed for the field is now to a greater extent met with critical reflections. Ranking policy goals above pedagogical goals in this field is largely contrary to teachers' understanding of teacher proficiency.

As an alternative to top-down initiatives, Langset et al. (2018) recommend a more horizontal approach that facilitates teacher educators' autonomy and ideas for new ways of doing things. One may envision an interesting turning point associated with digital technology in the education system.

The observation that teacher education is not successfully integrating digital tools can be related to the optimistic expectation related to the use of digital technology in our society (Player-Koro, 2013). We will need to critically examine the technological optimism, which has promoted a somewhat unrealistic view of the ability of digital tools in education. In the present study, only self-report and quantitative methods are used. To further address and validate the observations, we have conducted interviews with the academic staff to be published in a future qualitative study.

Teacher educators have developed an awareness regarding how digital technology is to be integrated into the curricula, and what kind of strategies are best suited to help pre-service teacher students obtain this knowledge for their future work. This paper may contribute to increasing such awareness, while simultaneously clarifying the content and the complicated processes of technology integration in teaching and learning. Argyris and Schön's highlighting of both single-loop and double-loop learning may add new perspectives to a deeper understanding of the ongoing process of developing a *sustainable* technologically enhanced learning.

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References:

Argyris, C. (1992). *On Organizational Learning*. Cambrindge, Massachusetts: Blackwell Publisher.

Argyris, C., & Schön, D. A. (1978). *Organizational learning : a theory of action perspective*. Reading, Mass: Addison-Wesley.

Argyris, C., & Schön, D. A. (1996). *Organizational Learning II. Theory, Method, and Practice*: Addison-Wesley Publishing Company, Inc.

Beck, E. E., & Øgrim, L. (2009). Bruke, forstå, forandre. Hva trenger elever å lære om IKT? In S. Østerud (Ed.), *Enter. Veien mot IKT-didaktikk* (pp. 175-190). Oslo: Gyldendal Norsk forlag.

Beland, L.-P., & Murphy, R. (2015). *Centre for Economic Performance, Discussion Paper No 1350. III Communication: Technology, Distraction & Student Performance*. London: Centre for Economic Performance, London School of Economics and Political Science.

Carter, S. P., Greenberg, K., & Walker, M. (2016). *Working Paper #2016.02 The Impact of Computer Usage on Academic Performance: Evidence from a Randomized Trial at the United States Military Academy*. Retrieved from SEII School effectiveness & inequality initiative: https://seii.mit.edu/wp-content/uploads/2016/05/SEII-Discussion-Paper-2016.02-Payne-Carter-Greenberg-and-Walker-2.pdf

Drent, M., & Meelissen, M. (2008). Which factors obstruct or stimulate teacher educators to use ICT innovatively? *Computers & Education, 551*(1), 187-199.

Elstad, E. (2006). Understanding the nature of accoutability failure in a technology-filled, laissez-fair classroom: disaffected students and teachers who ive in. *Journal of Curriculum Studies, 38*(4), 459-481.

Elstad, E. (2016a). Educational Technology - Expectations and Experiences: An Introductory Overview. In E. Elstad (Ed.), *Digital Expectations and Experiences in Education* (pp. 3-28). Rotterdam: Sense Publishers.

Elstad, E. (2016b). Introduction. In E. Elstad (Ed.), *Digital Expectations and Experiences in Education* (pp. VII-X). Rotterdam: Sense Publishesrs.

Elstad, E. (2016c). Why is there a wedge between the promise of educational technology and the experiences in a technology-rich pioneer school? In E. Elstad (Ed.), *Digital Expectations and Experiences in Education* (pp. 77-96). Rotterdam: Sense Publisher.

Engen, B. K., Giæver, T. H., & Mifsud, L. (2015). Guidelines and Regularions for Teaching Digital Competence in Schools and Teacher Education: A Weak Link? *Nordic Journal of Digital Literacy, 10*(2), 69-83.

Enochsson, A.-B., & Rizza, C. (2009). ICT in Initial Teacher Training: Research Review. *OECD Education Working Papers, No. 38*, OECD Publishing.

Farjon, D., Smits, A. & Voogt, J. (2019). Technology integration of pre-service teachers explained by attitudes and beliefs, competency, access, and experience. *Computers & Education*, 130, March 2019, 81-93. doi: https://doi.org/10.1016/j.compedu.2018.11.010

Hatlevik, O. E., Egeberg, G., Gudmundsdóttir, G. B., Loftsgarden, M., & Loi, M. (2013). *Monitor skole 2013. Om digital kompetanse og erfaringer med bruk av IKT i skolen*. Oslo: Senter for IKT i utdanningen.

Haugsbakk, G. (2013). From Sputnik to PISA Shock - New Technology and Educational Reform in Norway and Sweden. *Education Inquiry, 4*(4), 607-628.

Instefjord, E., & Munthe, E. (2016). Preparing pre-service teachers to integrate technology: an analysis of the emphasis on digital competence in teacher education curricula. *European Journal of Teacher Education, 39*(1), 77-93. doi: https://doi.org/10.1080/02619768.2015.1100602

King, B. M., Rosopa, P. J., & Minium, E. W. (2011). *Statistical reasoning in the behavioral sciences* (6th ed. ed.). New York: Wiley.

Krumsvik, R. J. (2011). *Den digitale lærar : digital kompetanse i praksis*. Oslo: Pedlex norsk skoleinformasjon.

Krumsvik, R. J. (2014). Teacher educators' digital competence. *Scendinavian Journal of Educational Research, 58*(3), 269-280. doi:https://doi.org/10.1080/00313831.2012.726273

Langset, I. D., Jacobsen, D. Y., & Haugsbakken, H. (2018). Digital professional development: towards a collaborative learning approach for taking higher education into the digitalized age. *Nordic Journal of Digital Literacy, 13*(1), 24-39.

Lund, A., Furberg, A., Bakken, J., & Engelien, K. L. (2014). What Does Professional Digital Competence Mean in Teacher Education? *Nordic Journal of Digital Literacy, 9*(4), 281-299.

Nelson, MJ., Voithofer, R. & Cheng, SL. (2019). Mediating factors that influence the technology integration practices of teacher educators. 128, January 2019, 330-344. https://doi.org/10.1016/j.compedu.2018.09.023

Madsen, S. S., Thorvaldsen, S., & Archard, S. (2018). Teacher educators' perceptions of working with digital technologies. *Nordic Journal of Digital Literacy, 13*(3), 177-196. doi:https://10.18261/issn.1891-943x-2018-03-04

May, C. (2014). A Learning Secret: Don't Take Notes with a Laptop. Retrieved from https://www.scientificamerican.com/article/a-learning-secret-don-t-take-notes-with-a-laptop/

MER. (2008). *Stortingsmelding nr. 11, Læreren, rollen og utdanningen*. Retrieved from Oslo: https://www.regjeringen.no/no/dokumenter/stmeld-nr-11-2008-2009-/id544920/

Mouza, C., Karchmer-Klein, R., Nandakumar, R. & Yilmaz Ozden S. (2014). Investigating the impact of an integrated approach to the development of preservice teachers' technological pedagogical content knowledge (TPACK). *Computers & Education*, 71(2), 206-221. doi: https://doi.org/10.1016/j.compedu.2013.09.020

Mueller, P. A., & Oppenheimer, D. M. (2014). The Pen Is Mightier Than the Keyboard: Advantages of Longhand Over Laptop Note Taking. *Psychological Science, 25*(6), 1159-1168.

OECD. (2010). *Are students ready for a technology-rich world? What PISA studies tell us*. Retrieved from Paris: https://www.oecd.org/education/school/programmeforinternationalstudentassessmentpisa/35995145.pdf

OECD. (2012). *Connected Minds. Technology and Today's Learners. Educational Research and Innovation*. Retrieved from Paris: https://www.oecd-ilibrary.org/docserver/9789264111011-en.pdf?expires=1542711724&id=id&accname=ocid195681&checksum=F77DF9188CE53DD5C055FEB4F9C06725

Player-Koro, C. (2013). Hype, hope and ICT in teacher education: a Bernsteinian perspective. *Learning, Media and Technology, 38*(1), 26-40.

Prensky, M. (2001). Digital Natives, Digital immigrants. *On the Horizon, 9*(5), 1-6. doi:https://doi.org/10.1108/10748120110424816

Selwyn, N. (2016). Minding our language: why education and technology is full of bullshit ... and what can be done about it. *Learning, Media & Technology, 41*(3), 437-443. doi:https://doi.org/10.1080/17439884.2015.1012523

Thorvaldsen, S., Egeberg, G., Pettersen, G. O., & Vavik, L. (2011). Digital dysfunctions in primary school: A pilot study. *Computers & Education, 56*(1), 312-319.

Tondeur, J., van Braak, J., Sang, G., Voogt, J., Fisser, P. & Ottenbreit-Leftwich, A. (2012). Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence. *Computers & Education*, 59 (2012), 134-144. https://doi.org/10.1016/j.compedu.2011.10.009

Tondeur, J., van Braak, J.,Tondeur, J., Siddiq, F. & Scherer, R. (2016). Time for a new approach to prepare future teachers for educational technology use: Its meaning and measurement. *Computers & Education*, 94 (2016), 134-150. https://doi.org/10.1016/j.compedu.2015.11.009

Tømte, C., & Olsen, D. S. (2013). *IKT og læring i høyere utdanning*. Retrieved from Oslo: http://osloedtech.no/wp-content/uploads/2016/03/NIFUrapport2013-32.pdf

UiT. (2016a). Lærerutdanning 1. - 7. trinn (Tromsø) - master (5-årig), lektor. Retrieved from https://uit.no/utdanning/program?p_document_id=280330

UiT. (2016b). Lærerutdanning 5. - 10. trinn (Tromsø) - master (5-årig), lektor. Retrieved from https://uit.no/utdanning/program?p_document_id=280681

Williams, C. & Beam, S. (2019). Technology and writing: Review of research. Computers & Education, 128, January 2019, 227-242. doi: https://doi.org/10.1016/j.compedu.2018.09.024

Ørnes, H., Wilhelmsen, J., Breivik, J., & Solstad, K. J. (2011). *Digital tilstand i høyere utdanning 2011: Norgesuniversitetets monitor* (Vol. nr. 1/2011). Tromsø: Norgesuniversitetet.