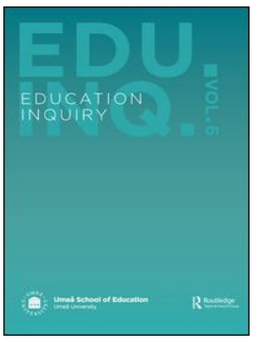

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The impact of specialised content courses on student teaching in a Norwegian teacher education programme

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ABSTRACT

In recent decades, most Nordic countries have seen reforms in their teacher education programme, giving rise to an ongoing debate on these programmes' content, structure, and quality. As part of a recent reform of teacher education in Norway, new Master's-level programme have been introduced to educate teachers for grades 5–10, whereby pre-service teachers (PSTs) take specialised content courses and undergo field placements twice a year. The purpose of this paper is to determine the effects of the specialised content courses on student teaching. In this study, we used a survey design to collect quantitative data from PSTs and qualitative data from mentor teachers. PSTs teaching subjects they specialised in had a more positive teaching experience related to perceived learning outcomes in subject matter knowledge and pedagogical content knowledge. The data from mentor teachers reinforce this finding; they reported that PSTs who taught subjects they specialised in showed faster learning progressions, were better at using different instructional strategies, and reflected more during guidance. The link between the specialised content courses and student teaching increases the coherence of the programme.

KEYWORDS

Teacher education; field placement; subject matter knowledge; subject specialisation; student teaching

Introduction

In recent decades, most Nordic countries' teacher education programmes have undergone reforms in both structure and content (Elstad, 2020) that have led to a greater emphasis being placed on subject specialisation, field placement, and differentiation based on school level. In 2010, elementary and lower secondary teacher education in Norway was divided into two separate programmes, namely elementary school (grades 1–7) and upper elementary and lower secondary school (grades 5–10). At the same time, UiT The Arctic University of Norway (UiT) started a national pilot programme for a five-year Master's degree. In this paper, we focus on the education programme for grades 5–10, which we will refer to as the 5–10-programme. This programme is special in the sense that it falls between a generalist education (i.e. the teacher teaches most school subjects) and specialist education (i.e. the teacher teaches only a few subjects). An important new feature in the 5–10-programme. is that pre-service teachers (PSTs)

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start with specialised content courses (subject specialisation) that integrate subject matter knowledge (SMK) and pedagogical content knowledge (PCK). These courses are distributed throughout the programme. The framework for the 5–10-programme in Norway highlights the requirement that field placement should be linked to the PSTs' specialised content courses across all academic years (Kunnskapsdepartementet, 2010).

According to research on teacher education programmes in Norway, it is unclear whether PSTs undergo field placement in the subjects they received coursework in (Følgegruppen for lærerutdanningsreformen, 2012). It is also unclear how field placement contributes to PSTs' development of PCK and SMK. A review of science teacher knowledge stated that how field placement interacts with PCK remains relatively unexplored and that relatively few studies have been conducted of how SMK develops during teaching (Van Driel, Berry, & Meirink, 2014). In the present study, we used a survey design to first investigate to what extent PSTs had opportunities to teach the school subjects they specialised in during their field placements. Second, we investigated how subject specialisation impacts student teaching. Data were collected from PSTs belonging to five different Master's subjects in the 5–10-programme as well as from their mentor teachers.

PSTs' field placement experiences

Student teaching in field placement has long been considered a cornerstone of teacher preparation and is most likely to affect PSTs' ability to raise student outcomes (Grossman, Cohen, Ronfeldt, & Brown, 2014; Klette, Blikstad-Balas, & Roe, 2017; Ronfeldt, 2012). Research on field placement in teacher education has mainly focused on changes in PSTs' attitudes and conceptions about their field placements. The findings are mainly positive, indicating that field placement is important for "good feelings" about the teacher role (Cohen, Hoz, & Kaplan, 2013). Field placements should, among other things, develop PSTs' teaching skills and professional abilities, and link the theoretical knowledge acquired in the teacher education programme to practical application in schools (Cohen et al., 2013). Researchers have pointed out that good coherence between subject coursework and extensive teaching in the subjects during field placement are indicators of high-quality teacher education programmes (Darling-Hammond, 2014; Grossman, Hammerness, McDonald, & Ronfeldt, 2008; Hammerness & Klette, 2015). Studies have shown that PSTs who undertake field placements closely associated with their courses at university are better able to make concrete linkages between their theoretical knowledge and classroom teaching (Allsopp, DeMarie, Alvarez-McHatton, & Doone, 2006; Nilssen & Solheim, 2015). The PSTs seem to better apply theoretical concepts when teaching and focus more on the students' learning during their field placements (Allsopp, DeMarie, Alvarez-McHatton, & Doone, 2006; Mohamed, Valcke, & De Wever, 2017; Nilssen & Solheim, 2015; Orland-Barak & Yinon, 2007; Tin, 2006). Therefore, good coherence between coursework and field placement is important for PSTs' education. Unfavourable outcomes of field placement activities have been documented; for example, PSTs have been found to have low success in their implementation of teaching approaches (Cohen et al., 2013). In addition, many field placements are reported to be too narrowly focused and disconnected from

the university courses. In this paper, we thus explore whether specialised content courses in the new Master's degree education programme can strengthen the linkage to field placement and give positive outcome.

Research on teacher education programmes has confirmed the vital role of field placement in the development of teachers' knowledge (Bullock, 2011; Van Driel et al., 2014). A teacher's knowledge is defined as "the total knowledge the teacher has to his or her disposal at a particular moment that underlies his or her actions" (Carter, 1990 cited in Van Driel et al., 2014, p. 848). One of the knowledge domains is pedagogical content knowledge (PCK), which can be defined as the knowledge a teacher needs to teach a subject (Shulman, 1987). Berry, Depaepe, and Van Driel (2016) indicated that the development of PCK is related to PSTs' SMK together with their teaching experiences during field placement. The development of PCK seemed to be improved by a programme design that integrates campus-based activities with authentic classroom teaching of the subject matter. In another study on PCK growth, Daehler, Heller, and Wong (2015) concluded that PSTs benefit from intertwining science learning and field placement in teacher education.

In a review of 57 studies focusing on SMK in teacher education, Wilson, Floden, and Ferrini-Mundy (2001) showed a positive connection between teachers' preparation in their subjects, better teacher performance in the classrooms, and higher student achievement, particularly in mathematics, science, and reading. Recent research on PSTs in physical education indicated that in-depth SMK and PCK are important for good teaching (Herold & Waring, 2017). This study and others have shown that limitations in PSTs' SMK lead to a lack of self-confidence and thus an adverse impact on their PCK and teaching (Harlen, 1997; Herold & Waring, 2017). Furthermore, the reviews showed that teachers with low SMK tend to rely heavily on textbooks, talk a lot, ask few open-ended questions, and avoid cognitively challenging activities (Abell, 2007; Loughran, 2014; Van Driel et al., 2014). Abell (2007) showed that PSTs need to take courses in PCK as well as SMK for professional development and concluded that "the evidence does support a positive relationship between SMK and teaching" (Abell, 2007, p. 1120). As the specialised content courses in the new 5–10-programme in the present study combined these two knowledge domains, it is interesting to investigate their impact on the PSTs' experiences in field placement.

A pilot study conducted with science PSTs in the 5–10-programme at UiT showed that the PSTs received considerably more teaching experience in their chosen subjects during their field placements than those in the previous general teacher education programme (Karlsen, Olufsen, Haugland, & Thorvaldsen, 2017). A follow-up study indicated that an early emphasis on SMK and increased focus on PCK in specialised content courses seemed to increase the quality of student teaching in the field placements (Olufsen, Karlsen, & Ødegaard, 2017). In this study, we compared PSTs with and without specialised content courses prior to teaching. We explored their teaching experiences and their mentor teachers' perspectives on student teaching. Therefore, these results contribute to the ongoing debate on the effect of subject specialisation and coherence in teacher education programmes.

Theoretical framework and research question

Many studies have developed models to describe teachers' knowledge domains. They range from the early model of Shulman (Shulman, 1987) to more recent models (Gess-Newsome, 2015; Magnusson, Krajcik, & Borko, 1999). In these models, there are three key components of professional knowledge: general pedagogical knowledge, PCK, and SMK. Shulman (1987) defines general pedagogical knowledge as a broad range of principles and strategies of classroom management and organisation that is transcend to SMK. Nixon, Hill, and Luft (2017) defined SMK as the understanding of facts, concepts, and practices of a scientific discipline (for example, Social Studies or English). PCK is defined as what teachers know about how their students learn specific subject matter or topics. PCK also includes knowledge on how to use representations and activities in that subject or topic, and which misconceptions and difficulties students may face (Van Driel et al., 2014). Kind (2009) reviewed nine PCK models and found that the majority of them favour combining SMK within PCK. There is also some evidence that expert teachers do not perceive SMK and PCK as separate knowledge bases, but that SMK is rather included within the PCK knowledge base. In the 5–10-programme in Norway, these are considered to be two distinct knowledge domains that are both incorporated within the specialised content courses. In our study, we view PCK and SMK together as one learning outcome from field placement.

As the literature overview has shown, a coherent teacher education programme that links coursework with field placement is considered an important element of good teacher education (Hammerness & Klette, 2015). Coherence can be divided into "conceptual" and "structural" coherence (Grossman et al., 2008; Hammerness, 2006). Conceptual coherence is achieved if there is a shared conception of teaching in the educational programme and if theory and practice are intertwined. Hammerness (2006, p. 1242) described structural coherence as follows:

> Structural aspects of coherence might include organizing and aligning courses and student teaching placement around a particular conception of teaching and learning in an effort to construct an integrated experience, or trying to create courses that build sequentially on one another and reinforce one another.

In this paper, we focus on structural coherence. We investigated PSTs' experiences from student teaching with and without specialised content courses. Towards that end, we explored the following two research questions:

(1) Did the PSTs have specialised content courses in the subjects they taught during field placement?
(2) How does PST subject specialisation impact student teaching and their perceived learning outcome?

Context

The 5–10-programme at UiT is composed of three school subjects of choice and 70 credits' worth of courses in pedagogy and student knowledge (PED) (UiT, 2017). UiT follows the standard European Credit Transfer and Accumulation System (ECTS) for all academic courses. The subject courses are specialised content courses for teachers that integrate subject matter and pedagogical content knowledge. The PSTs receive 40

Table 1. Overview of the structure of the 5–10-programme PED courses are marked in grey, and specialised content courses are in brown. Weeks of field placement are included in the table.

Year		Field placement (weeks)	Subject[1]		
1	Autumn	3	PED (10)	Master's subject (40)	
	Spring	3	Ex. phil.[2] (10)		
2	Autumn	3	PED (20)	Subject 2 (40)	
	Spring	3			
3	Autumn	3	PED (20)	Master's subject (20)	Subject 2 (20)
	Spring	3			
4	Autumn	2	Subject 3 (30)		
	Spring	2	PED (10)	PED (10)	Research methods (10)
5	Autumn	0	Master's subject (30)		
	Spring	0	Master's thesis (30)		

[1]Credits (ECTS) are in parentheses.
[2]Examen philosophicum.

credits in their master's degree subject in the first year, and an additional 20 and 30 credits when they continue with their master's subject in the third and fifth year, respectively (Table 1). The PSTs start with Subjects 2 and 3 in their second and fourth year, respectively. The pedagogy and student knowledge courses run parallel with the other school subjects over the first four years of the programme. In the third year, PSTs conduct a research and development (R&D)-based bachelor thesis, and in the fifth year, the PSTs write a Master's thesis on subject didactics. Students in the 5–10-programme have 22 weeks of supervised field placement distributed over the first four years (UiT, 2017). As described in the introduction, the framework of the programme emphasises that the field placement should be linked to the PSTs' specialised content courses for all academic years (Kunnskapsdepartementet, 2010). During the first three years, the PSTs have six weeks of field placement every academic year: three weeks in the autumn and three weeks in the spring. Usually, the PSTs are put together in groups of three in their field placements with a mentor teacher at the school. The mentor usually teaches in one or more of the subjects the PSTs have specialised in.

Methods

This study consisted of two parts, one quantitative and one qualitative. The participants in the quantitative part were PSTs in the first three years of the 5–10-programme at UiT on the Tromsø campus. In 2016 and 2017, all PSTs in their first three academic years were invited to participate in the survey. The online questionnaire, developed using Questback (an online survey tool), was answered by 172 PSTs (71%). The PSTs were in the following academic years: 78 in their first year, 60 in their second year, and 34 in their third year. The PSTs could choose a Master's degree in didactics among the following subjects: English, Mathematics, Natural Science, Norwegian, and Social

Studies. We chose to include PSTs in all these subjects in our study. The participants in the qualitative part of the study were mentor teachers from the field placement who had recently supervised PSTs in the 5–10-programme In total, 35 (52%) mentor teachers answered open-ended questions, mostly on paper, but some answered the questionnaire online in Nettskjema (a tool for designing and conducting online surveys).

To ensure the PSTs remembered details clearly, the data were collected shortly after the end of their last annual field placements. The questions mainly focused on the last of the two annual field placements. We believe that the participants, both the PSTs and the mentor teachers, constitute a typical sample of a Norwegian teacher education programme. Norwegian teacher education programmes are homogeneous, following the same national educational framework, and the structures of the education programmes are quite similar (Kunnskapsdepartementet, 2010). Two PSTs and two field placement administrators piloted the initial survey. We refined the questionnaire based on the feedback from the pilot panel.

Questionnaire design

After the field placements were completed, PSTs answered the questionnaire about their field experiences. In the questionnaire, the PSTs specified the number of hours they taught each subject during their field placement and which courses they had taken. Most of the PSTs taught several subjects during field placement. In some of these subjects, the PSTs had taken specialised content courses from university (subject specialisation) prior to field placement. Other than these, the PSTs also taught subjects in which they had no specialisation. The PSTs were asked to agree or disagree with three statements for each subject they had taught. These statements were connected to their experiences with teaching the specific subject, and this were the only questions in the questionnaire related to the student teaching of different subjects. Here is an overview of the statements (the example is from the subject English):

Indicate your agreement with the following statements (concerning your teaching experience in **English**):

1. *"My subject matter knowledge in **English** is good"*
2. *"I had a good learning outcome in subject matter knowledge and pedagogical content knowledge from teaching **English** during field placement"*
3. *"My lessons in **English** gave the pupils a good learning outcome."*

The PSTs answered on a five-point Likert scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *neutral*, 4 = *agree*, 5 = *strongly agree*). The questionnaire was quite general and included complex concepts. Ideally, we should have investigated this with a multi-item measure. Because we did not have rich enough data to make multi-item constructs, we chose to analyse the questions with a single-item measure. This is a limitation of this study, but we believe that the three statements together give valuable insight into the experiences the PSTs had with teaching several different subjects in field placement. Single-item measures have been utilised in various research areas from education (Toma, Villagra, & Perez Gonzalez, 2019; Wanders, Dijkstra, Maslowski, Van Der Veen, & Amna, 2020), marketing (Bergkvist & Rossiter, 2007), and psychology (Buhr, Daniels, & Goegan, 2019). In most cases multiple-item measurements will favour singe-

item measurements. But in cases, with small sample size, weak effect sizes, and if the items are homogenous and sematic redundant single items measurements are preferable (Diamantopoulos, Sarstedt, Fuchs, Wilczynski, & Kaiser, 2012). Single-item measurements are also suitable in exploratory studies. This study has an exploratory nature as it investigates a problem that is not well understood and with a relatively small sample size. In addition, the PSTs are experienced with the concepts used in the questionnaire as these are key concepts in their education. Based on these aspects, we argue that the use of a single-item measure is appropriate for this paper.

In the qualitative part of our study, we analysed two open-ended questions from the mentor teachers' questionnaire. The mentor teachers were asked whether or not they experienced any difference in teaching quality between PSTs with and without subject specialisation in the subjects they taught. If they had experienced any differences, they were asked to describe these in detail. The mentor teachers knew in which subjects their PSTs had taken specialised content courses. We also asked if they thought PSTs should teach more subjects than just those they had specialised in and to argue their opinions. We developed open-ended questions to validate and better understand the quantitative results. The data from the mentor teachers were collected in 2017 and 2018, while the PST data were collected in 2016 and 2017.

Quantitative data on PSTs' perceived PCK and SMK learning outcomes combined with qualitative data on mentor teachers' experiences with PSTs teaching practice in different subjects enable a discussion of the relationship between subject specialisation and teaching quality. Earlier research has identified a clear connection between teachers' knowledge (SMK and PCK) and quality instruction (Seidel & Shavelson, 2007). This connection is evident for features of quality instruction such as cognitive activation and individual learner support (Fauth et al., 2019). However, it is important to note that learning outcomes in SMK and PCK are not equal to quality instruction. For example, the translation from knowledge for teaching to teaching practice is limited by features of the teacher such as self-efficacy (Klassen & Tze, 2014), and features of the context such as mentor teacher's view of teaching (Crawford, 2007).

Data analysis

We wanted to investigate whether PSTs with and without subject specialisation had different field placement experiences from teaching the same subjects. The PSTs answered the questionnaire after their teaching experiences. Figure 1 shows how the data were divided and analysed. The data were divided into two sets based on whether or not the PSTs had specialisation in the subjects they taught. Student's *t*-tests and Cohen's *d* effect size were used to determine whether there was a substantial difference between groups. The following interpretations of Cohen's *d* were applied: 0.2 = small effect, 0.5 = medium, and 0.8 = large effect (King, Rosopa, & Minium, 2011, p. 267). The *t*-tests were applied directly to the five-point Likert scale data (De Winter & Dodou, 2010). The quantitative data were analysed with SPSS version 24 (Windows).

To identify the themes in the open-ended questions, we used thematic analysis following Braun and Clarke (2006). We coded whole sentences and paragraphs and grouped the mentor teachers' answers according to whether they thought that subject

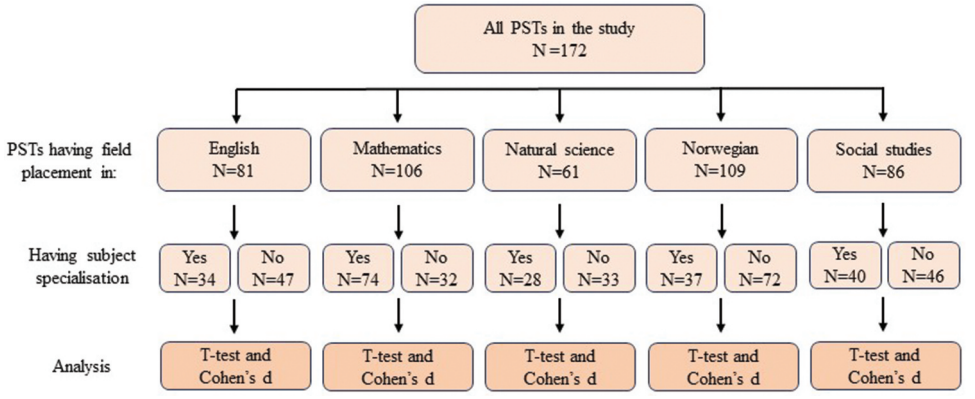

Figure 1. Overview of how the quantitative data is divided and analysed

specialisation was important for teaching quality. For each group, relevant data for each code were collated under themes. We looked for similar and different opinions among the teachers, and quotes from various mentor teachers were selected to illuminate different aspects and to show variations in opinions between teachers. Good examples of teaching practices that could explain how the PSTs' subject specialisation influenced their teaching are presented in the result section. The present study follows the guidelines for ethical standards by The Norwegian National Research Ethics Committees (2021).

Results

The amount of student teaching in different school subjects

After the final field placement, the PSTs reported the amount of student teaching they had done in each subject and which subjects they had specialised content courses in. Table 2 gives an overview of which subject the PSTs experienced teaching and the extent of the teaching experience. There were large differences in the percentage of PSTs who taught different subjects. This corresponded quite well with the volume of the

Table 2. Overview of the amount of student teaching the PSTs did in school subjects.

Subject	*N*	%	Volume of teaching *M* (*SD*)*
Arts and Crafts	34	20	2.59 (1.84)
Christianity, Religion, Philosophies of Life and Ethics	38	22	1.97 (1.17)
English	76	44	3.63 (2.17)
Food and Health	15	9	3.33 (1.63)
Mathematics	105	61	3.53 (2.24)
Music	11	6	3.45 (2.70)
Natural Science	60	35	2.60 (1.27)
Norwegian	108	63	3.69 (2.30)
Physical Education	85	49	2.67 (1.90)
Social Studies	82	48	2.83 (1.76)
Total	172		

* Scale: 1 = 1–2 hours, 2 = 3–4 hours, 3 = 5–6 hours, etc.

subject in the school curriculum. PSTs received most teaching experience in the subjects that is given the most priority in the curriculum; more than 60% gained teaching experience in Norwegian and Mathematics. The PSTs received less training in the practical and aesthetic subjects Music (6%), Food and Health (9%), and Arts and Crafts (20%). These subjects are only taught a few hours per week in Norwegian schools. Although the percentages of PSTs who taught these subjects were small, the PSTs who taught these subjects received, on average, a similar amount of total teaching experience as those teaching other subjects.

An analysis of the data shows that during the field placement, on average, 95% of the PSTs in the first three academic years taught in the subjects they had specialisation in. The five Master's degree subjects (English, Mathematics, Natural Science, Norwegian, and Social Studies) were examined, showing only minor differences between the different subjects. Typically, the PSTs were assigned mentor teachers who also taught the subjects they specialised in, ensuring that the PSTs received supervision in these subjects. In light of this, it is expected that a high percentage of the PSTs taught in their chosen subjects. Even so, these results show that most PSTs did student teaching in the subjects they had specialised content courses in every field placement period during the first three academic years.

We also explored how many different school subjects each PST taught during field placement. The PSTs were only asked to report the number of hours of instruction for which they were responsible in the class. Only the last of the two annual field placements was investigated in this study. On average, PSTs reported teaching in 3.6 different subjects in total, but with a greater variety of school subjects in their first two academic years, averaging 3.8 subjects. The PSTs typically had a field placement in elementary schools during these years. In the third year, when the PSTs were typically placed in lower secondary school, the PSTs taught 2.6 different subjects on average. These results show that especially during the first two years of the field placement, PSTs had to teach multiple subjects. PSTs in their first academic year took specialised content courses in one subject only, while second and third-year PSTs specialised in two subjects. This means that first-year PSTs taught almost three subjects without subject specialisation on average, while second and third-year PSTs taught between one and two subjects without subject specialisation on average. Therefore, during field placement, most PSTs had to teach some subjects with and without subject specialisation (university courses). In the next section, we explore whether subject specialisation had an effect on PSTs' teaching experience.

PSTs' experiences with teaching different subjects

The PSTs responded to three statements for every subject they taught during field placement. In the first statement, the PSTs were asked to rate their subject matter knowledge (SMK) in a particular subject. As expected, the PSTs with subject specialisation reported having higher SMK than those without specialisation. Cohen's d varied from 0.6 to 1.9, and all had significant differences in means. The largest effect size was in Mathematics (1.9). The lowest SMK across all subjects was in Mathematics, reported by PSTs without specialisation. One explanation is that Mathematics is a subject that many PSTs find difficult. This subject has among the highest failure rates on exams in Norwegian upper secondary schools. PSTs

without subject specialisation have to rely on knowledge from their own schooling when teaching. If their SMK from their schooling is poor, they will probably experience difficulty in teaching mathematics and report accordingly. Other quantitative studies have also shown that it is easier to see an effect in Mathematics than in other subjects when taking teachers' educational levels into account (Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2009; Goldhaber & Brewer, 1997).

In the second item of the questionnaire, the PSTs were asked to rate the statement: "I had a good learning outcome in SMK and PCK from teaching 'subject' during field placement." For all subjects, PSTs with subject specialisation reported higher perceived learning outcomes in PCK and SMK than those without specialisation in the subject (see Table 3). The effect sizes were in the range from 0.6 to 1.2 and all means were significantly different. The average number of hours the PSTs taught in every subject was correlated quite well with the effect sizes. On average, the PSTs received more teaching experience in Norwegian, English, and Mathematics, and the effect sizes were all high for these subjects (1.0–1.2). The PSTs gained less teaching experience in Social Studies and Natural Science. For these subjects, the effect sizes were medium (0.6 and 0.7). This indicates that the PSTs' perceived learning outcomes in SMK and PCK increased with the number of hours the PSTs taught in each subject. The third item required the PSTs to rate the statement "my lesson in 'subject' gave the pupils a good learning outcome." The average score across all subjects with and without subject specialisation was 4.2 and 3.8, respectively. Both average scores are relatively close to a score of 4, meaning that the PSTs agree with the statement that their teaching gave the pupils a good learning outcome. However, the PSTs with subject specialisation reported giving their pupils higher learning outcomes. This applied to all five of the studied school subjects. The effect sizes ranged from 0.6 to 1.0 and all means were significantly different (see Table 3).

The data show that the PSTs with subject specialisation in Natural Science reported lower assessments on all three questions than did PSTs in other subjects. One explanation is that the subject of Natural Science in school combines chemistry, physics, biology, and geology, possibly making it broader in scope than other subjects. Therefore, the PSTs may have felt they did not master it as well as other subjects. Social Studies is also a school subject that encompasses several scientific disciplines. However, we did not see the same effect on this subject. Across all three statements for all subjects, the standard deviations were higher in the group of PSTs without subject specialisation, indicating greater variation in the answers for this group. The group without subject specialisation prior to field placement had to rely on their SMK knowledge from school when teaching, and this knowledge base can be highly varied.

Mentor teachers' evaluation of the PSTs' teaching

For a broader perspective, the mentor teachers were asked whether they had experienced any differences in teaching ability between PSTs with and without subject specialisation. They were also requested to describe these possible differences. Most PSTs taught several subjects during field placement. Therefore, the mentor teachers observed PSTs teaching some school subjects with and some without subject specialisation. In general, the mentor teachers were positive regarding PSTs teaching several

Table 3. Overview of the three statements the pre-service teachers (PSTs) rated for every subject they taught during field placement, with a comparison between PSTs with subject specialisation and those without subject specialisation. T-tests and Cohen's d effect sizes were calculated.

	My SMK in subject is good					I had a good learning outcome in SMK and PCK from teaching 'subject' during my field placement					My lesson in 'subject' gave the pupils a good learning outcome				
	Specialisation		No specialisation			Specialisation		No specialisation			Specialisation		No specialisation		
	N	*M* (*SD*)	*N*	*M* (*SD*)	*d*	*N*	*M* (*SD*)	*N*	*M* (*SD*)	*d*	*N*	*M* (*SD*)	*N*	*M* (*SD*)	*d*
English	34	4.0 (0.8)	47	3.3 (0.9)	0.8**	34	4.4 (0.7)	47	3.4 (1.1)	1.2**	34	4.3 (0.6)	47	3.6 (0.7)	1.0**
Mathematics	74	4.3 (0.7)	32	3.0 (0.8)	1.9**	74	4.4 (0.6)	32	3.5 (1.0)	1.1**	74	4.2 (0.5)	32	3.6 (0.7)	1.0**
Natural Science	28	3.9 (0.6)	33	3.4 (0.9)	0.6*	28	4.2 (0.6)	33	3.8 (0.8)	0.6*	28	4.1 (0.5)	33	3.7 (0.7)	0.6*
Norwegian	37	4.3 (0.7)	72	3.5 (0.8)	1.2**	36	4.5 (0.6)	72	3.9 (0.8)	1.0**	37	4.4 (0.5)	72	3.9 (0.6)	0.8**
Social Studies	40	4.2 (0.6)	46	3.5 (0.8)	1.0**	40	4.3 (0.7)	46	3.8 (0.8)	0.7**	40	4.2 (0.6)	46	3.8 (0.7)	0.6*
All subjects	213	4.2	230	3.4	1.1	212	4.4	230	3.7	0.9	213	4.2	230	3.8	0.8

(*$p < 0.05$, ** $p < 0.005$)

school subjects. Most of the mentor teachers stated that the PSTs should teach all subjects because this is the reality in Norwegian schools today. They also emphasised that field placement should give PSTs broad experience in teaching methods, classroom management in various school subjects, and the teaching profession. Three mentor teachers mentioned their teaching experiences in Norwegian as particularly important, because reading and writing should be included in all school subjects. Mentor teachers also stated that by teaching subjects without subject specialisation, the PSTs faced more challenges and were tested outside their comfort zones. However, three mentor teachers working in lower secondary school thought that the PSTs should only teach the subjects they had a formal background in and emphasised that SMK was very important for good teaching. Most mentor teachers in our study worked in primary schools and often had a background as generalist teachers. We see that these mentor teachers did not emphasise SMK to the same extent. They thought it was more important to teach many different subjects, to meet the school's needs, and get used to the reality in Norwegian schools where teachers have to teach many subjects.

Of the 32 mentor teachers who answered the question about the quality of student teaching, 23 stated that PSTs with subject specialisation gave better instruction than those without. Six of the mentor teachers had not experienced any differences in the PSTs' instruction. Three mentor teachers had mentored only PSTs who taught the subjects in which they specialised. It is clear from this result that the quality of teaching increased when the PSTs had specialisation. The mentor teachers described the PSTs with subject specialisation as more confident and at ease when teaching. They also pointed out that the PSTs seemed to reflect more in the supervising process when they had an adequate background in the subject and its didactics. The mentor teachers reported that PSTs who had SMK and PCK from university courses progressed faster in the process of learning to teach. Specifically, the mentor teachers pointed out that the PSTs were able to use different learning strategies and methods to vary their teaching and they used the knowledge or experiences gained from their courses. Furthermore, the PSTs had more knowledge about the learning goals of the subjects they had specialisation in. The mentor teachers also experienced that the PSTs with subject specialisation were more curious and creative and more eager to try out new ideas and inquiry-based teaching. A mentor teacher stated, "The PSTs seemed more secure safer and dared to do some nontraditional things and use more teaching methods and learning strategies." Another mentor teacher said, "The PSTs use the experiences they have from the university courses in their teaching." The last quotation also shows that PSTs who took courses in the subject were able to link their specialised content courses with their field placement and apply their knowledge in their teaching.

Some mentor teachers claimed that PSTs who taught in subjects in which they lacked specialisation used unfinished and less detailed lesson plans. Several mentor teachers reported that the PSTs were less motivated to teach the subjects in which they lacked specialisation. Among the mentor teachers who did not report a difference in teaching skills, some mentioned that the teaching quality depended largely on the PSTs' preparation. PSTs with a limited background in a particular subject's SMK spent extra time on lesson planning and were more focused when they taught. A mentor teacher stated, "PSTs may have to prepare even more

thoroughly for the teaching in subjects they have not had. They have to learn the subject material." The overall analysis of the qualitative data showed that the majority of the mentor teachers stated that there was a link between the PSTs' subject specialisation and the teaching quality in these subjects.

Discussion

In this study, we collected data from PSTs and their mentor teachers in the 5–10-programme at the Arctic University of Norway. When we analysed which school subjects the PSTs taught during their field placements, we found that 95% taught the subjects they had had university courses in (subject specialisation). As this study included PSTs in their first three academic years, this result showed that most PSTs taught the school subjects in which they had specialisation every year. The specialised content courses in the 5–10-programme include a mix of subject matter knowledge (SMK) and pedagogical content knowledge (PCK). Thus, during the first three academic years, the PSTs acquired knowledge and skills in SMK and PCK and were given the opportunity to try out these theories and skills in field placement twice a year. The mentor teachers also experienced that the PSTs made use of their knowledge from the specialised content courses when they taught in schools. This indicates that there is structural coherence between the specialised content courses and field placement. This finding is in accordance with the national framework and the intention of the local programme plan, which highlights the requirement that PSTs should receive field placement in the subject they have chosen (Kunnskapsdepartementet, 2010; UiT, 2017). The good coherence between coursework and field placement is also recognised as a quality indicator of teacher programmes (Darling-Hammond, 2014; Grossman et al., 2008; Hammerness & Klette, 2015). In this study, we examined only the five subjects available for PSTs to choose as Master's degree subjects. For other subjects, such as practical and aesthetic subjects, the same structural coherence would not be present as these subjects could not be taken in the first years of the educational programme.

This study shows that PSTs practice teaching in several subjects without specialisation. When teaching school subjects other than those in which they participated in specialised content courses, the PSTs could not make use of SMK and PCK from the courses or relate their field experiences back to courses after field placement. Evidently, there is a weak structural coherence for these subjects. Especially in the first two years, when the PSTs did field placement in elementary schools, they taught multiple school subjects. A typical elementary school teacher in Norway has to teach many subjects in school, including subjects in which the teacher lacks subject specialisation. PSTs seems to be trained during field placement in the same tradition as their mentor teachers. During field placement, the PSTs teach most subjects even though they only have subject specialisation in one or two of them. We can infer that SMK and PCK are not recognised as important in field placement in elementary schools. In a previous study, we found that mentor teachers experienced that PSTs from the 5–10-programme were more reluctant to teach school subjects without subject specialisation than PSTs from the 1–7-programme. PSTs from the 5–10-programme also identified themselves more with the subjects they specialised in (Karlsen & Olufsen, 2019). This result

indicates that the PSTs experience student teaching without subject specialisation as demanding.

We explored the effect of student teaching in some subjects with specialisation and others without specialisation. As expected, the PSTs reported having higher SMK in subjects they had subject specialisation in. PSTs' self-confidence will most likely increase when they take specialised content courses (Menon & Sadler, 2016), and this can have an effect on the results. The data from mentor teachers support the results from the PSTs. They stated that PSTs with subject specialisation showed faster learning progression during field placement. They also reported that the PSTs were better at using different instructional strategies, had more knowledge of learning goals in the subject, and reflected more during guidance. The present findings are supported by a study of science PSTs in the same educational programme (Olufsen et al., 2017). The mentor teachers in that study reported that knowledge in science and PCK had increased in the new Master's degree programme, which emphasised subject specialisation. The mentor teachers stated that the PSTs used the knowledge and teaching activities they had learned in the specialised content courses in field placement. They also reported that the PSTs performed more inquiry-based teaching and practical activities during field placement. In the 5–10-programme the PSTs start with specialised content courses in their first year and our study shows that most PSTs get teaching experience in these subjects every year.

Van Driel et al. (2014) stated in a review that developing SMK and PCK simultaneously while teaching can have positive outputs. The teachers can then become aware of their own gaps in SMK and at the same time learn how pupils perceive the content. Other studies showed that PSTs who undergo field placement closely associated with their coursework are better able to apply theoretical concepts when teaching (Mohamed et al., 2017; Nilssen & Solheim, 2015). The combination of specialised content courses and field placement in the 5–10-programme seems to facilitate this synergy effect. PSTs who use their knowledge from coursework to try out different teaching strategies and are creative when they teach would most likely improve the learning outcomes. The mentor teachers' answers in this study, therefore, agreed with what PSTs reported: Having coursework prior to field placement had a positive effect on the perceived learning outcomes in SMK and PCK from field placement. Other studies have shown that teachers' SMK has an effect on teaching quality. For example, teachers with low SMK tend to rely heavily on textbooks, ask few open-ended questions, and avoid challenging activities (Abell, 2007; Loughran, 2014; Van Driel et al., 2014). The mentor teachers in this study also observed these kinds of differences between PSTs with and without subject specialisation. They stated that the PSTs with subject specialisation achieved higher-quality teaching. This result indicates that PSTs with subject specialisation increased pupils' learning outcomes; this is an argument for having specialised content courses that integrate SMK and PCK. There is agreement in the literature that teachers who are knowledgeable in SMK and PCK increase pupils' learning outcomes (Gustafsson, 2003; Herold & Waring, 2017; Hill, Rowan, & Ball, 2005; Wilson et al., 2001). The results would most likely hold for PSTs as well.

In the present study, we did not consider varied academic backgrounds and the effect they might have on the quality of instruction. PSTs without subject specialisation have to rely on their knowledge from school when doing student teaching. The PSTs' SMK from upper secondary school can vary greatly, as they often have quite different

backgrounds in Mathematics, Natural Science, Social Studies, and English. Some PSTs have studied these subjects for only one year, while others have these subjects for all three years, like Norwegian, which most PSTs studied for three years at upper secondary school.

This study shows the importance of having university courses in the subjects the PSTs teach during field placement and getting experience in these subjects over several years. This is not always the case in the education of Norwegian elementary and lower secondary school teachers. We showed that PSTs in the 5–10-programme teach multiple school subjects without subject specialisation. The 5–10-programme is between generalist education and specialist education, and this education programme is quite new. In the future, it will be important to debate what the main goals of the field placement should be. If the emphasis is on improving subject matter knowledge (SMK) and pedagogical content knowledge (PCK), this study supports PSTs doing more student teaching in the subject they have specialised content courses in. This might increase the quality of field placement, which will benefit PSTs and pupils. This study indicates that having specialised content courses that include SMK and PCK has a positive impact on PSTs' student teaching and their learning outcomes in field placement. However, this should be investigated more thoroughly. In the future, in-depth studies of what PSTs with and without subject specialisation learn from field placement would shed more light on these issues.

Disclosure statement

No potential conflict of interest was reported by the authors.

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References

Abell, S. K. (2007). Research on science teacher knowledge. In S. K. Abell & N. G. Lederman (Eds.), *Research on science teacher education* (pp. 1105–1149). New York: Routledge.

Allsopp, D. H., DeMarie, D., Alvarez-mchatton, P., & Doone, E. (2006). Bridging the gap between theory and practice: Connecting courses with field experiences. *Teacher Education Quarterly*, *33*(1), 19–35.

Bergkvist, L., & Rossiter, J. R. (2007). The predictive validity of multiple-item versus single-item measures of the same constructs. *Journal of Marketing Research*, *44*(2), 175–184.

Berry, A., Depaepe, F., & Van Driel, J. H. (2016). Pedagogical content knowledge in teacher education. In J. Loughran & M. L. Hamilton (Eds.), *International handbook of teacher education* (Vol. 1, pp. 347–386). Singapore: Springer.

Boyd, D. J., Grossman, P. L., Lankford, H., Loeb, S., & Wyckoff, J. (2009). Teacher preparation and student achievement. *Educational Evaluation and Policy Analysis*, *31*(4), 416–440.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101.

Buhr, E. E., Daniels, L. M., & Goegan, L. D. (2019). Cognitive appraisals mediate relationships between two basic psychological needs and emotions in a massive open online course. *Computers in Human Behavior*, *96*, 85–94.

Bullock, S. M. (2011). *The development of Teachers' professional knowledge*. Inside Teacher Education: Rotterdam: SensePublishers.

Carter, K. (1990). Teachers' knowledge and learning to teach. In W. R. Houston (Ed.), *Handbook of research on teacher education* (pp. 291–310). New York: Macmillan.

Cohen, E., Hoz, R., & Kaplan, H. (2013). The practicum in preservice teacher education: A review of empirical studies. *Teaching Education*, *24*(4), 345–380.

Crawford, B. A. (2007). Learning to teach science as inquiry in the rough and tumble of practice. *Journal of Research in Science Teaching*, *44*(4), 613–642.

Daehler, K. R., Heller, J. I., & Wong, N. (2015). Supporting growth of pedagogical content knowledge in science. In A. Berry, P. Friedrichsen, & J. Loughran (Eds.), *Re-examining pedagogical content knowledge in science education* (pp. 45–59). New York/Abingdon: Routledge.

Darling-Hammond, L. (2014). Strengthening clinical preparation: The Holy Grail of Teacher education. *Peabody Journal of Education*, *89*(4), 547–561.

De Winter, J. C. F., & Dodou, D. (2010). Five-point Likert items: T test versus Mann-Whitney-Wilcoxon. *Practical Assessment, Research, and Evaluation*, *15*, 1–16.

Diamantopoulos, A., Sarstedt, M., Fuchs, C., Wilczynski, P., & Kaiser, S. (2012). Guidelines for choosing between multi-item and single-item scales for construct measurement: A predictive validity perspective. *Journal of the Academy of Marketing Science*, *40*(3), 434–449.

Elstad, E. (2020). *Lærerutdanning i nordiske land*. Oslo: Universitetsforlaget.

Fauth, B., Decristan, J., Decker, A.-T., Büttner, G., Hardy, I., Klieme, E., & Kunter, M. (2019). The effects of teacher competence on student outcomes in elementary science education: The mediating role of teaching quality. *Teaching and Teacher Education*, *86*, 102882.

Følgegruppen for lærerutdanningsreformen. (2012). *Med god gli i kupert terreng: GLU-reformens andre år* (9788299897716). Retrieved from http://www.uis.no/getfile.php/F%C3%B8lgegruppen%20for%20l%C3%A6rerutdanningen%20%28FFL%29/Rapport%202%20fra%20F%C3%B8lgegruppen.pdf

Gess-Newsome, J. (2015). A model of teacher professional knowledge and skill including PCK: Results of the thinking from the PCK summit. In A. Berry, P. Friedrichsen, & J. Loughran (Eds.), *Re-examining pedagogical content knowledge in science education* (pp. 28–42). London: Routledge.

Goldhaber, D. D., & Brewer, D. J. (1997). *Evaluating the effect of Teacher degree level on educational performance*. Development in Schools Finance, 1996. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=ED406400&site=ehost-live

Grossman, P., Cohen, J., Ronfeldt, M., & Brown, L. (2014). The test matters: The relationship between classroom observation scores and Teacher value added on multiple types of assessment. *Educational Researcher*, *43*(6), 293–303.

Grossman, P., Hammerness, K. M., McDonald, M., & Ronfeldt, M. (2008). Constructing coherence: Structural predictors of perceptions of coherence in NYC teacher education programs. *Journal of Teacher Education*, *59*(4), 273–287. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=ehh&AN=33990334&site=ehost-live

Gustafsson, J. E. (2003). What do we know about effects of school resources on educational results? *Swedish Economic Policy Review*, *10*(2), 77–110.

Hammerness, K. (2006). From coherence in theory to coherence in practice. *Teachers College Record*, *108*(7), 1241–1265.

Hammerness, K., & Klette, K. (2015). Indicators of quality in Teacher education: Looking at features of teacher education from an international perspective. *International Perspectives on Education & Society*, *27*, 239–277.

Harlen, W. (1997). Primary teachers' understanding in science and its impact in the classroom. *Research in Science Education*, *27*(3), 323.

Herold, F., & Waring, M. (2017). Is practical subject matter knowledge still important? Examining the Siedentopian perspective on the role of content knowledge in physical education teacher education. *Physical Education and Sport Pedagogy*, *22*(3), 231–245.

Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of Teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal*, *42*(2), 371–406.

Karlsen, S., & Olufsen, M. (2019). To ulike utdanninger for skolens mellomtrinn. Er det samsvar mellom planverk og praksislæreres erfaringer med studentenes kompetanser på 1-7 og 5-10 utdanningene? *Acta Didactica Norge*, *13*(1), 1–27.

Karlsen, S., Olufsen, M., Haugland, O. A., & Thorvaldsen, S. (2017). Et tidlig gløtt inn i den nye norske lærerutdanningen - En komparativ studie av allmennlærer- og masterutdanning i naturfag for grunnskolen. *UNIPED*, *40*(4), 299–311.

Kind, V. (2009). Pedagogical content knowledge in science education: Perspectives and potential for progress. *Studies in Science Education*, *45*(2), 169–204.

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

Klassen, R. M., & Tze, V. M. C. (2014). Teachers' self-efficacy, personality, and teaching effectiveness: A meta-analysis. *Educational Research Review*, *12*, 59–76.

Klette, K., Blikstad-Balas, M., & Roe, A. (2017). Linking instruction and student achievement. A research design for a new generation of classroom studies. *Acta Didactica Norge*, *11*(3), 10.

Kunnskapsdepartementet. (2010). *Forskrift om rammeplan for grunnskolelærerutdanningene for 1.–7. trinn og 5.–10. trinn*. Retrieved from https://lovdata.no/dokument/SF/forskrift/2010-03-01-295

Loughran, J. J. (2014). Developing understanding of practice. science teacher learning. In N. G. Lederman & S. K. Abell (Eds.), *Handbook of research on science education* (Vol. 2), pp. 811-829. London: Routledge.

Magnusson, S., Krajcik, J., & Borko, H. (1999). Nature, sources, and development of pedagogical content knowledge for science teaching. In J. Gess-Newsome & N. G. Lederman (Eds.), *Examing pedagogical content knowledge*. (pp. 95-132). Dordrecht: Kluwer academic publishers.

Menon, D., & Sadler, T. D. (2016). Preservice elementary Teachers' science self-efficacy beliefs and science content knowledge. *Journal of Science Teacher Education*, *27*(6), 649–673.

Mohamed, Z., Valcke, M., & De Wever, B. (2017). Are they ready to teach? Student teachers' readiness for the job with reference to teacher competence frameworks. *Journal of Education for Teaching*, *43*(2), 151–170.

Nilssen, V., & Solheim, R. (2015). 'I see what I see from the theory I have read.' Student teachers learning through theory in practice. *Journal of Education for Teaching*, *41*(4), 404–416.

Nixon, R. S., Hill, K. M., & Luft, J. A. (2017). Secondary science Teachers' subject matter knowledge development across the first 5 years. *Journal of Science Teacher Education*, *28*(7), 574–589.

The Norwegian National Research Ethics Committees. (2021). Research ethics. Retrieved from https://www.forskningsetikk.no/en/topics/

Olufsen, M., Karlsen, K., & Ødegaard, M. (2017). Endringer i lærerstudenters kompetanser? En casestudie fra en ny lærerutdanning ved UiT Norges arktiske universitet. *Nordic Studies in Science Education*, *13*(2), 117–133.

Orland-Barak, L., & Yinon, H. (2007). When theory meets practice: What student teachers learn from guided reflection on their own classroom discourse. *Teaching and Teacher Education*, *23* (6), 957–969.

Ronfeldt, M. (2012). Where should student teachers learn to teach?: Effects of field placement school characteristics on teacher retention and effectiveness. *Educational Evaluation and Policy Analysis*, *34*(1), 3–26.

Seidel, T., & Shavelson, R. J. (2007). Teaching effectiveness research in the past decade: The role of theory and research design in disentangling meta-analysis results. *Review of Educational Research*, *77*(4), 454–499.

Shulman, L. S. (1987). Knowledge and teaching: foundations of the new reform. *Harvard Educational Review*, *57*(1), 1–22.

Tin, T. B. (2006). Looking at teaching through multiple lenses. *ELT Journal*, *60*(3), 253–261.

Toma, R. B., & Meneses Villagrà J. À., J. C. (2019). Validation of the single-items Spanish-School Science Attitude Survey (S-SSAS) for elementary education. *Plos One*, *14*(1), 18.

UiT. (2017). *Studieplan for integrert mastergradsprogram - lærerutdanning 5.-10. trinn*. Retrieved from https://uit.no/Content/511020/cache=20192003143713/Studieplan-master-i-l%C3%A6rerutdanning-5-10-trinn-h%C3%B8st-2017-kull-2013-2016-.pdf

Van Driel, J. H., Berry, A., & Meirink, J. (2014). Research on science teacher knowledge. In N. G. Lederman & S. K. Abell (Eds.), *Handbook of research on science education* (Vol. II) , pp. 848-870. New York: Routledge.

Wanders, F. H. K., Dijkstra, A. B., Maslowski, R., Van der Veen, I., & Amna, E. (2020) The role of teachers, parents, and friends in developing adolescents' societal interest. *Scandinavian Journal of Educational Research*, 1-16.

Wilson, S. M., Floden, R. E., & Ferrini-Mundy, J. (2001). *Teacher preparation research: Current knowledge, gaps and recommendations*. Retrieved from https://depts.washington.edu/ctpmail/PDFs/TeacherPrep-WFFM-02-2001.pdf