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Published in:
Educational Action Research

DOI:
10.1080/09650792.2019.1684969

Published: 01/01/2019

Document Version
Accepted author manuscript

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This is an original manuscript of an article published by Taylor & Francis in *Educational Action Research* on 21 October 2019, available online: *http://www.tandfonline.com/10.1080/09650792.2019.1684969*

Student teachers' experiences of action research-based projects: Two cases within pre-service teacher education in Finland

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Abstract

During the last decade, Finnish teacher education (TE) has received special interest due to the Finnish students' success in PISA. Although TE in Finland has many strengths, there are also challenges that need to be addressed. One of the main challenges is the relation between theory and practice. As action research (AR) has been suggested as one possible tool for bridging the theory-practice gap and simultaneously supporting the forming of the foundational steps for an inquiry stance to continue through the teaching career, an AR orientation in the pre-service stages is of particular interest in this study. The aim is to explore student teachers' (STs') experiences of AR-based projects within two different contexts of Finnish TE, characterized by various paradigms: a class and a subject TE programme. The analysis revealed experiences of both constraints and affordances. Some of these are identified among both groups of STs, albeit somewhat differently characterized in the two contexts, others, again, are context specific. The results show that both groups of STs value their experiences of the AR-based projects. However, the results give important insights into STs' experiences of both constraints and affordances that merit further consideration when implementing AR-based projects within pre-service TE.

Introduction

In connection to an increase in the number of recurring international comparative surveys such as PISA, PIRLS and TIMSS, the interest in teacher education (TE) has increased during the last decade, alongside discussions of the prerequisites for developing education in national contexts. In the wake of these discussions, Finnish TE has received special interest due to the Finnish

students' success in PISA in particular. Although TE in Finland has many strengths, there are also challenges and dilemmas that need to be addressed. One of the main challenges is the relation between theory and practice (cf. Bendtsen 2016) and how to integrate these to a higher extent, a common challenge in TE worldwide (see e.g. Clarke and Fournillier 2012; Kemmis, McTaggart and Nixon 2014). In addition, there is an increased need in a fast-changing world to educate teachers who know how to learn from and about teaching by adopting an 'inquiry stance' to their own continuing professional development (see e.g. Cochran-Smith et al. 2009). Another challenge facing the Finnish educational context concerns the relative lack of support for newly qualified teachers in the induction stages (see e.g. Tynjälä and Heikkinen 2011), despite the agreement by European Union member states already in 2007 to ensure the coordination, cohesion, funding and quality of the different stages from pre-service education onwards (Commission of the European Communities 2007). Niemi (2015) states that the learning and professional development of teachers throughout the career should be seen as a continuing process equated with school development. This more holistic approach asked for in educational contexts today is supported through the research-based orientation in TE that enables in-service teachers to take on the design of school-based projects (see also Tynjälä and Heikkinen 2011).

To further support such a holistic approach, an action research (AR) orientation in the pre-service stages is of particular interest in the context of our study, as AR has been suggested as one possible tool for bridging the theory-practice gap and simultaneously supporting the forming of the foundational steps for an inquiry stance to continue through the teaching career (cf. Ferrance 2000; Heissenberger and Matischek-Jauk 2019; Kosnik and Beck 2000; Smith and Sela 2005; Timperley et al. 2007). However, this context is twofold: in Finland, there are specific TE programmes for educating class teachers for grades 1–6 and subject teachers for the later grades, with differing structures and characterized by various paradigms (see e.g. Hansén, Forsman, Aspfors and Bendtsen 2012). Thus, the aim of this article is to explore student teachers' (STs') experiences of AR-based projects within two different contexts of pre-service TE: a class and a subject TE programme.

Action research in pre-service TE

It needs to be stated already at the outset that a univocal definition of AR is challenging to provide, considering its varieties of forms and use in local contexts (see discussions e.g. in Kemmis and McTaggart 1994; Kemmis, McTaggart and Nixon 2014; Somekh and Zeichner 2009). Kemmis and McTaggart (1994) describe AR as involving people in making critical analyses aimed at discovering how situations have been socially and historically constructed, and using this as a source of insight into ways in which we might be able to construct them. A feature in all variations of AR is the importance of working towards improved practices and knowledge generation through a reflective process of inquiry, whether this be individual or collaborative. According to Gibbs et al. (2017), AR in TE and teaching practice is predominantly used in a technical and practical manner rather than for emancipatory ends, and often focusing first-person practitioner research aimed at improving individual teaching practice rather than a collaborative process. Also in our context, the AR set-ups have so far primarily been individual rather than collaborative, with the aim of bridging the gap between theory and practice as part of an inquiry stance through the more technical and practical ends that pre-service TE has the possibility of providing.

In the AR process, a characteristic expected to be found entails some more or less dynamic variety of the self-reflective spiral originally suggested by social psychologist Kurt Lewin and consisting of the following steps: *planning, action, observation,* and *reflection*. Although e.g. Kemmis, McTaggart and Nixon (2014) suggest that the process be seen as more dynamic than a strict set of steps – and that the most central is the interrogation of the actual practice itself – the spiral has shown to be a concrete scaffold for participants to structure their AR work in a focused manner (see also Kemmis and McTaggart 1994).

Despite a renewed interest in AR in pre-service TE from the mid-80s onwards (see e.g. Lattimer 2012), Kosnik and Beck (2000) state that not a great deal had appeared on the topic in the research literature by 2000. However, presently the number of small-scale case studies reported in the literature seems to be steadily increasing, often conducted by teacher educators involved in the process and focusing the experiences of participating students, as reported by e.g. Lattimer (2012) (see also Gibbs et al. 2017). Lattimer suggests that findings are generally positive, but typically site-based and thus hard to generalize from. To find out whether AR can provide differential impact, Lattimer conducted a comparative mixed-methods study between two TE programmes, one involving AR. Results suggest no significant difference between the

two programmes regarding knowledge and skills, e.g. the ability to reflect, but an added value from the AR programme regarding dispositions such as graduates taking ownership of their work as professional educators and expressing an increased appreciation for the purpose of reflection. This is in line with the main reasons for including AR in pre-service TE in our context, i.e. to support the development of an integrated view of theory and practice and an 'inquiry stance' into STs' approach to their future profession (cf. Cochran-Smith et al. 2009; Niemi 2015; Smith and Sela 2005). In relation to this holistic purpose, it is relevant to remember Elliott's (e.g. 1991) criticism regarding the way academia has tended to appropriate AR to be used in the service of technical rationality, the very paradigm that it was developed to counteract (cf. Carr and Kemmis 2005; Kemmis and McTaggart 1994; see also Gibbs et al. 2017). As a consequence, he maintains, educational research is too often viewed as something teachers do on rather than for their practice. To Elliott, such separation of 'research' from 'teaching' means a separation between teaching and curriculum development, whereas the idea of developing the curriculum through teaching presupposes a unified concept of teaching as a reflective practice.

The Toronto-based one-year BEd programme involving AR described by Kosnik and Beck (2000) included elements such as teachers engaging in critical reflection on specific aspects of their curriculum and pedagogy, getting to know their students well, interacting with them, observing them and gathering 'data', critically engaging with the research literature relevant to their research and collaborating with their peers. The teachers also modified curriculum and pedagogy in ways that empowered their students and met a wide range of their needs, including academic ones. Finally, the students presented and discussed their research publicly. Although not all teachers will include all of the above elements, Kosnik and Beck suggest that to teach well, teachers should have many elements of this *approach* to knowledge, practice and the teacher-student relationship.

For an example in the Nordic context, Jakhelln and Pörn (2018) investigated the challenges in supporting and assessing AR projects related to bachelor's theses for research-based pre-service TE in Norway. The results show a lack of communication and tripartite collaboration among students, practicum teachers and university teachers. It is suggested that the lack of tripartite collaboration is partly the reason why the relationship between practice and theory is weak in most of the theses.

In a TE programme for secondary school teachers in Norway, Ulvik and Riese (2016) found the use of AR to be a mainly positive experience for the participants in the end, although not

without its challenges: As the preservice teachers were occupied with their master's studies at the same time, they found it challenging to prioritize their AR projects within a smaller module of 5 credit points. The authors conclude that most important is to provide enough time for in-depth reflection. They also suggest that another area in need of specific attention even after a completed AR project is familiarizing students with research and linking theory and practice (cf. Jakhelln and Pörn 2018). Also Kosnik and Beck (2000), despite drawing mainly positive experiences from their BEd programme, stress the need of support at different stages. They suggest that one of the main benefits with an AR approach in TE is that STs are offered a challenge entailing both responsibility and 'real' demands, but supported to the extent that they feel they are allowed to take risks. This in turn entails a feeling of ownership of their AR projects, which makes STs more involved and cause them to focus more attention on the theory of the actual topic at hand, compared to fulfilling traditional given assignments. At the same time, they found the STs forming a more holistic view of their students and their learning environment, including reflecting on and evaluating their own performance. Thus, research suggests enough benefits to warrant the inclusion of AR into pre-service TE to be studied in a context where it has not previously been used in an extensive and systematic manner.

Methodology

Class and subject teacher education – depicting the context

TE in Finland is divided into class TE (for grades 1–6) and subject TE (for grades 7–9 in lower secondary and the three grades comprising upper secondary education). The two TE programmes are characterized by common features, but also by differences. Class and subject TE have been university-based since the 1970s and have a strong research-based approach. In line with the Bologna declaration, the education consists of a two-cycle degree system that includes undergraduate studies leading to a Bachelor's degree and graduate studies resulting in a Master's degree. The TE programme comprises 300 ECTS and is designed to be completed in five years (ECTS refers to the European Credit Transfer System). In class TE, the main subject is educational science (about 140 ECTS) and STs gain insights into areas such as general didactics, educational psychology, educational sociology and educational philosophy (cf. Jakku-Sihvonen et al. 2012). In subject TE on the other hand, the main subject is the science

connected to a school subject (about 140 ECTS, e.g. mathematics, psychology), whereas educational science (60 ECTS) constitutes one of two minor subjects.

STs further write their bachelor's and master's theses about education in class TE and about their respective sciences in subject TE. Class STs also acquire broad competence in all subjects taught in primary schools and they usually choose to specialise in one or two subjects. If they opt for further studies in a subject, they can be certified to teach that subject in lower secondary school (cf. Hansén and Eklund 2014; Niemi and Jakku-Sihvonen 2011). Practice-oriented activities (about 20 ECTS), both within class and subject TE, are mainly organised in university practice schools and only to some extent in field schools. A strong tradition in tripartite collaboration among lecturers in the practice school, lecturers at the Faculty of Education and STs, provides opportunities for creating coherence between settings and closer links between theory and practice (cf. Aspfors & Eklund 2017; Bendtsen 2016; Canrinus, Bergem, Klette and Hammerness 2017; Toom et al. 2010). The aim of the research-based approach underlying TE is to qualify reflective, autonomous, responsible and professional teachers who can base their teaching on research principles and successfully use the principles to address the practical challenges in the profession (Krokfors et al. 2011; Tirri 2014). Specific research activities form an essential part of TE. STs read and write scientific texts and take specific research methodology courses. Furthermore, they carry out their own research projects for their bachelor's and master's theses, they use scholarly methods and gain insights into scientific tools. (Cf. Hansén et al. 2015; Jakku-Sihvonen and Niemi 2006; Kansanen 2014.) For further insights into the Finnish educational context, see Aspfors, Eklund, Hansén and Wikman 2018)

Action research-based projects within teacher education – two cases

Within the two TE programmes that form the context of the current study, AR-based projects have been implemented in different ways. In class TE, STs have the possibility to choose AR as methodology for their master's thesis, and their AR based projects are carried out during an optional practice period in field schools outside the university context, while in subject TE the AR based small-scale projects are carried out during a mandatory practice period at the university practice school.

In class TE at Åbo Akademi University, STs can largely decide what topic they want to investigate in their master's thesis. In collaboration with their supervisor, the STs can further choose if they want to write a theoretical or an empirical study. In a case study carried out by Eklund (2019), it was clear that few STs choose to carry out a thesis with an AR approach. The master's theses written with an AR approach are quite different in character, the projects are carried out in different grades, various methods of data collection and analysis are used and STs' own engagement as teachers versus researchers vary. For the AR projects in this study, the students chose topics connected to the teaching of different subjects in primary school, in that five focused on language teaching, three on physical education, and one on music education. One had the character of a self-development project and focused on the teacher's way of responding to code switching in a classroom setting, while the other ones aimed to explore and develop teaching methods.

In subject TE, small scale AR-based projects have been applied within the language TE programme at Åbo Akademi University since 2015. The projects form an integral part of a 19-week-semester during which theoretical courses set at the Faculty of Education alternate with two integrated practice periods at the university practice school. The aim of the AR-based projects is for STs to develop their own teaching practice within a chosen field, using AR as a tool for professional development. The fifteen projects in this study explored various teaching tools and methods, such as the use of music, poetry, and movement in language teaching. The rest of the projects (n=5) were oriented towards self-development and included topics such as how to interact with students during grammar teaching, and how to make one's teaching more authentic through the use of lyrics for vocabulary learning. The supervisors introduce the projects and as in the class TE, supervisors tutor the STs both individually and in small groups throughout the process.

Informants, data collection and analysis

In this study, the data was collected from the two cases described above. In the first case, nine class STs were interviewed about their experiences of writing a master's thesis with an AR approach. A total number of 171 master's theses were written during 2015–2017 by class STs, and in ten of these, AR was used as research approach. Of the ten STs who had applied an AR approach, nine (6 female and 3 male) agreed to be interviewed. All the informants were aged

between 25 and 30 and educated as class teachers, but specialised in various subjects such as special needs education, music and physical education. At the time when the AR-based projects were carried out, the informants had little or no working experiences as professional teachers.

In the second case, the experiences of two cohorts of subject STs, who had conducted small-scale AR-based projects as part of their pre-service TE, were explored. They were all future language teachers who completed their TE during two subsequent years, 2017 and 2018. The first group consisted of twelve and the second included ten STs, out of which eleven and nine STs respectively, participated in the study. Out of the twenty STs who agreed to be interviewed, seventeen were female and three male. At the time of the interview, the STs were aged between 23 and 29 and fourteen of them had completed their studies for a Master's degree, whereas six of them still had had a few courses or their master's thesis to finish. Four STs had no previous experiences of working as a teacher, whereas the rest reported anything from a few days up to approximately three years of teaching experience.

The class STs were interviewed after they had completed their master's theses and most of them had been working as teachers for a while, while the subject STs were interviewed shortly after they had completed their TE studies. All interviews were semi-structured, the interview guides focused on STs' experiences of AR-based projects, and included four common themes. These were background characteristics, experiences of the AR-based projects, visions for the development of the projects as a tool in TE and finally the perceived usefulness of the projects for their future work. For the purpose of this study, the focus was specifically on STs' experiences connected to the AR-based projects.

In relation to each theme, several interview questions were asked, and when appropriate, follow-up questions were asked as well. All informants were interviewed by the researchers, the interviews lasted between 20 and 45 minutes and were recorded and transcribed verbatim. The study follows the general ethical standards approved by the Finnish Advisory Board on Research Integrity (2016).

All data were analysed in an inductive manner by means of conventional qualitative content analysis (Hsieh and Shannon 2018; see also Atkins and Wallace 2012; Boeije 2010; Schreier 2012). Data from the two cases were initially analysed separately. In the first phase, the researchers read repeatedly and carefully through the transcripts and selected the essential parts relevant for this study. Ideas and thoughts were further noted and discussed jointly. STs'

experiences connected to the AR-based projects were analysed and an open coding procedure was conducted resulting in many different initial codes, or themes. The codes were then collected under potential categories. The researchers discussed and compared the preliminary results in relation to the research questions. In the second phase, the researchers did a more systematic coding and the emerging codes were compared for similarities and differences. The categories were checked in relation to the coded extracts and the entire data set. The data was subsequently condensed and abstracted into a smaller number of categories which were then labelled in order to capture the different dimensions of each category. Finally, the analysis resulted into two category systems; one defining STs' experiences of constraints, and one describing STs' experiences of affordances concerning the AR-based projects (cf. Willing 2013). Although the two cases were initially analysed separately, continuous discussions and peer debriefing among the collaborating researchers were carried out in order to make the process of analysis as reliable as possible and to ensure the trustworthiness of the study (cf. Angen 2000).

Findings

The constraints and affordances identified in the two cases are presented jointly. To some extent similar categories emerged in both contexts but as the presentation will show, the character of the categories can differ due to the different contexts. The categories are described and illustrated with original extracts from the interviews and the informants are identified by school level (C/S), and number (cf. Creswell 2013; Smith 2015). The responses were translated into English by the authors.

Constraints

Five different categories of constraints were identified in connection to the use of AR based projects: *expectations and attitudes towards the AR-based project, structural constraints, unfamiliarity with AR, lack of teaching experience,* and *combining teaching practice and AR.* The first and the last category appeared only among the subject STs (Table 1).

Table 1. Constraints identified among STs.

Category	Class STs (n=9)	Subject STs (n=20)
Expectations and attitudes towards the AR-based project	-	13
Structural constraints	8	16
Unfamiliarity with AR	3	15
Lack of teaching experience	4	2
Combining teaching practice and AR	-	11

When it comes to the STs' **expectations and attitudes towards the AR-based project** a clear difference between the two cases can be noted. Since the class STs had themselves chosen to carry out their master's thesis in the form of an AR-based project, they all expressed positive attitudes towards the project. The subject STs, for whom the projects were an integrated part of their education, had rather negative expectations initially (13/20). They expected the process to be comprehensive, difficult and laborious, especially in combination with other tasks they were expected to carry out in relation to the TE programme. In some cases, this resulted in low motivation and in retrospect, some STs (6/20) express that they could have put more effort into the process: *Unfortunately it became one additional thing among other things… I felt as if there wasn't enough time to really get involved.* (S-20). A further reason for negative attitudes was the fact that for some subject STs (3/20) the small-scale projects were not considered scientific enough.

The vast majority of STs (8/9 and 16/20, respectively) recognizes **structural constraints** related to time, organizational matters and/or co-operation. First of all, seven class STs (7/9) and seven subject STs (7/20) mention limitations related to time. The class STs found that the AR-based projects were very time-consuming and required a lot of work from them. They were often ambitious and some of them even wanted to do more work than required. However, there was often not enough time to fulfil their ambitions: *You really need to read up and it requires quite a lot of you. You cannot simply think that "oh well I will just do that"… but you actually need to immerse yourself* (C-3). The subject STs, on their part, express frustration over issues

such as limited time for preparations, planning and especially implementation, since the TE programme included only a limited amount of lessons during which to carry out their research.

Secondly, both groups of STs also found organizational matters challenging. The class STs (7/9) were frustrated concerning how organizational matters affected the outcome of their AR-based projects. One ST mentioned the pupils' absence and unwillingness to participate in the interviews while another, who investigated immigrant pupils, found that the pupils did not have the language skills needed for the interviews. In addition, a few class STs experienced they had too little control over the data collection process. The subject STs, on their part, expressed that their limited control over matters such as schedules and teaching content meant that the planning process was unnecessarily disrupted or postponed. *It is difficult when you only have a general idea of what you are going to do but you cannot make detailed plans of, for instance, what a questionnaire will look like, when you don't know whether it should be aimed at grades seven to nine or the upper secondary level* (S-15).

Thirdly, some class (2/9) and subject (3/20) STs express that they would have liked more co-operation with their fellow students and opportunities to work together on the AR-based projects: *Many write their master's thesis together and it would perhaps have been good to have a research partner* (C-7). Furthermore, two class STs (2/9) experienced the co-operation with the teachers and the personnel at the schools as difficult. For example, in order to carry out the master's thesis in this particular way, one ST explains that it was up to her to find a teacher who was willing to participate in the AR-based project.

Next, **unfamiliarity with AR** is a challenge recognized by the majority of the subject STs (15/20) and also a few class STs (3/9). None of the STs had previous experience of the method and underwent a stage of initial confusion as they tried to grasp what AR is all about and what type of work it implies. Thus, they were unsure about methodological issues, such as how best to collect data, the amount of data needed, how to document the process in a scientific way and the appropriateness of their chosen topic for an AR study. As one subject ST explains; *The documentation… how subjective or objective should one be…since it is all about your own development as a teacher it feels more natural to write relatively subjectively, but when it comes to research and results you think you would need to be objective* (S-15). Since so few fellow students had written their master's thesis with an AR approach, the class STs found it difficult to find useful information about the method and the research process: *When writing other kinds of master's theses, one can check what others have done, but since this method is so new, there*

aren't any models to turn to (C-4). Consequently, they would have appreciated more feedback from their supervisor during the process.

For some of the STs (4/9 and 2/20, respectively) their **lack of teaching experience** was considered problematic. The subject STs express that it was difficult to get started and to choose a topic for their study due to their inexperience. As one of them explains: *First you need to become aware of your own teaching and what needs to be developed. It is not really possible to choose a subject if you don't know what you are like as a teacher* (S-5). In contrast, the class STs found it difficult to watch and analyse their own performance documented on the videos and they became very self-conscious and critical towards their own teaching: *It's primarily the self-critical part of having to deal with the fact that one has not conducted the lesson in the best way possible. I planned the lessons in detail, but then there wasn't enough time and I started to hurry through the lessons with the pupils and it did not turn out as I had thought…* (C-9).

The final category, **combining teaching practice and AR**, is only identified among the subject STs (11/20). The STs experienced practical, ethical as well as cognitive challenges when having to carry out research while they were teaching. When it comes to practical challenges, the STs mention difficulties such as adapting the research to fit with the aims and content of the lessons or having to carry out research and documentation at the same time as they were teaching. A small group of STs (3/20) express ethical concerns regarding the pupils at the practice school, who were subjected to their research projects. As one of them explains, it is a matter of finding a balance between implementing your project and considering what would be best from the pupils' point of view. *There are so many other things you need to include, so implementing your AR, which for the most part benefits you, without letting it influence the quality of the teaching the students get – that was perhaps the biggest challenge* (S-1). Finally, combining research with teaching can also be cognitively challenging, as one ST explains: *there isn't sufficient time to immerse yourself in the practice context when you immediately have to start thinking about the research* (S-6).

Affordances

In terms of affordances, four common categories are identified among the two groups of STs. These are *scaffolds, relations, agency,* and *systematic analysis and knowledge construction.* Furthermore, *increased practical experience* is recognized as an affordance by the class STs,

while the subject STs' experiences included three additional categories of affordances; *connection between theory and practice, transfer between contexts,* and *own enactment* (Table 2).

Table 2. Affordances identified among STs.

Category	**Class STs (n=9)**	**Subject STs (n=20)**
Scaffolds	8	19
Relations	8	10
Agency	7	17
Systematic analysis and knowledge construction	4	16
Increased practical experience	4	-
Connection between theory and practice	-	11
Transfer between contexts	-	10
Own enactment	-	7

Almost all STs (8/9 and 19/20, respectively) point out different kinds of **scaffolds** in relation to the two different AR-based projects. The class STs highlight the AR method in itself and the setup of the project as scaffolds whereas the subject STs highlight scaffolds surrounding the AR process. The class STs thus experienced AR as an interesting and well-working method for writing a master's thesis: *In my opinion AR was the method that felt most appropriate since it allows you to be both the researcher and the object of research at the same time* (C-6). They found the method flexible and appreciated having something concrete to go back to in the form of empirical data such as interviews and diaries. The subject STs, on their part, emphasized the importance of scaffolds such as clear instructions, assigned literature on AR, an example of an AR report written by a former ST, as well as formal opportunities for planning, presenting, and sharing. Consequently, for the subject STs, the scaffolds made the task more concrete and clear and supported their time and task management.

Formal as well as non-formal **relations** are emphasized as affordances among both groups of STs. In both cases (8/9 and 10/20 respectively), the formal relation with the supervisor is seen as essential for the process. The STs felt that the supervisor helped with both practical and theoretical issues and played an important role in providing affirmative feedback and support:

She (the supervisor) *was very helpful and she also joined me when I visited the school for the first time. She helped me a lot with the AR itself because there wasn't that much* (information) *about it* (C-7). Additionally, non-formal relations with other teachers were noted by both groups of STs. The subject STs appreciated the support and feedback from university lecturers and the teachers at the practice school, while the class STs noted the well-working cooperation with the teachers in the schools where they conducted their AR-based project.

However, an essential difference could be identified between the two groups. The subject STs especially emphasized the role of peers (11/20). More specifically, fellow STs were seen as important sounding boards that not only provided new perspectives but also assurance and affirmation: *If we got really stuck we got together and discussed or exchanged frustrations. You got good pointers and advice* (S-18). In contrast, the class STs, who carried out their AR-based projects outside the university context, did not have the same opportunities for peer-collaboration and a few of them pointed out this disadvantage. Instead, one class ST (1/9) particularly appreciated the good and interesting discussions with the pupils.

Opportunities for **agency** were recognized by seven class STs and seventeen subject STs. However, in the two contexts, these opportunities are realized in different ways. For the class STs, opportunities for agency were connected to development of professional competence and self-awareness. Thus, they felt that the AR-based projects allowed them to get better insights into themselves as teachers and enabled them to develop competence for the profession: *In that way it is practical. You develop and reflect on your teaching and have contact with your pupils. It felt very relevant for the future* (C-9). For the subject STs, the opportunities for agency were more specifically related to the learning process rather than the outcome. For one thing, the fact that the projects were introduced early on, was seen to provide opportunities for managing one's time and working process. The STs further stressed the importance of being allowed to choose their own research topic, as this enabled a focus on issues responding to their current developmental needs and interests. In this way, the projects became meaningful, relevant and useful in their eyes. As one ST explains: *it has been an opportunity for learning something new and interesting, which I want to continue developing, even after the education* (S-15).Thus, when the process is not too rigidly structured or externally controlled, it provides opportunities for exploration, information seeking, and adaptation.

Both groups of STs (4/9 and 16/20 respectively) appreciated the opportunities for **systematic analysis and knowledge construction** that the AR-based projects presented. For one thing, the

systematic, focused way of working helped the STs make their learning and development more visible. As one of the STs expresses: *You automatically analyze what happens in the classroom, but this* (AR methodology) *makes it more visible and more focused* (S-18). For the subject STs, the AR-based project was also seen as a tool for professional development and knowledge construction. *I think it was a good way of looking at the situation from a different perspective and in that way get more knowledge about it* (S-11). Similarly, one class ST stated that the AR-based project enabled her to develop critical and analytic thinking by combining her own thoughts and experiences with scientific literature. In that way, she got valuable knowledge from the project, and learnt to use her own experiences as a source for research. Further, the class STs explicitly emphasized that the analysis of the different teaching situations developed their professional teaching skills.

The following category is only identified among the class STs. The class STs (4/9) wrote their master's thesis as an AR-based project and they appreciated the **increased practical experiences** that the project afforded**.** They expressed that they gained useful practical skills, especially since the AR-based project was carried out at schools not connected to the TE programme: *Now, when I have been working for half a year, I feel that I learned a lot during my AR process. I believe you learn much more* (from using AR) *than when you do a traditional master's thesis because you do things in practice* (C-3).

The last three categories were only identified among the subject STs. First, eleven of the twenty subject STs pointed out how AR can function as a **connection between theory and practice**. Included here is an understanding of how theory can contribute to learning and development in general and to learning in a practice setting in particular. As one ST explains: *It pretty much combines all the theory and practice we had and I think it is a good way in which a teacher can develop her own teaching, also with the help of theory. Not just noticing that something may or may not be working, but that you then, with the help of theory, try to develop and perhaps do it a little differently next time* (S-19).

Secondly, within the context of TE, the AR-based projects can also provide opportunities for **transfer between different learning contexts**, an aspect pointed out by half the subject STs (10/20). For instance when choosing a topic for their studies, the STs drew on what they had learnt in different courses but also on their own experiences in the classrooms. One subject ST (S-18) mentioned that she listened attentively during lectures, in case something on her topic would be included. As part of her data collection process, another subject ST (S-11) used a

video of herself teaching that she had recorded for a different course, allowing for an even more versatile analysis of the video.

Finally, the subject STs (7/20) point out the benefits of having gone through the research process themselves, as opposed to just reading or hearing about it. Through their **own enactment** they felt they got a greater appreciation and awareness of how AR can be applied and what can be learnt from such a process. This in turn, potentially increases the chances of using the tool and applying it in one's future practice as the following statement illustrates: *I think it is great to have gone through all this and to have had this practice. Because if there is anything that you start thinking about that isn't really working, in say, five to ten years' time, then it won't be a big deal to use this method* (S-1).

Discussion

The aim of this article has been to explore STs' experiences of AR-based projects within two different contexts of pre-service TE, a class and a subject TE programme. The fact that the study only comprises two TE programmes and a relatively small number of participating STs is recognized as a limitation to the study. However, although the number is too small to generalize from, the results give important insights into both constraints and affordances that merit further consideration when implementing AR-based projects in pre-service TE.

Some of the constraints and affordances found in the study are shared between the two groups of STs although somewhat differently characterized in the two contexts, others, again, are context specific. Structural constraints are emphasized by both groups of STs, especially in relation to time and organization of the projects. Despite contextual differences, the STs found the AR-based projects quite demanding, which can be explained in terms of the nature of the projects. AR-based projects are inherently complex regarding STs' dual role as teacher and researcher, the use of multi-methods as well as the close interactions with different parties such as supervisors, practice teachers and pupils. The complex character of AR as a method in combination with the fact that the STs were unfamiliar with the approach resulted in uncertainty in terms of both process and product (cf. Jakhelln and Pörn 2018). When it comes to the process, the supervisor was very important, especially for the class STs, who did not have the support from other parties. Moreover, almost all STs emphasize the importance of scaffolds, both in

terms of the quality of the outcome but also when it comes to ensuring that the process runs smoothly (see e.g. Kosnik and Beck 2000; Ulvik and Riese 2016).

Whereas the similarities identified could largely be explained in terms of the nature of AR, the differences can mainly be related to context. In subject TE, the AR-projects were an integrated part of an intensive study period including both theoretical courses and practice periods set at the university practice school. This resulted in both negative and positive experiences. On the negative side, the subject STs initially regarded the project as problematic since it was such an extensive project that had to be carried out on top of all the other tasks that were included in their programme. Similar time constraints were found by Ulvik and Riese (2016). On the positive side, the fact that the TE programme for the subject STs was concentrated whilst including alternating sojourns in both university and practice settings, evidently provided the STs with opportunities for drawing on both theory and practice and for connecting between the two settings as they carried out their AR projects. As pointed out by Canrinus, Bergem, Klette and Hammerness (2017), tighter links between courses and practice setting can improve the connection between theory and practice. These experiences also suggest the promotion of a more holistic view of the teaching and learning process similar to what was found by Kosnik and Beck (2000).

Furthermore, the context of subject TE enabled a close relation to peers, which was highly appreciated by the STs. A similar support system was not available for the class STs, who carried out their projects outside the university context. Then again, the class STs emphasized the opportunities for increased practical experience afforded through their AR-based projects and the fact that the practice was carried out in a context other than the university practice school. Thus, in comparison to the subject STs, their experiences seem not to have worked to further a more integrated view of theory and practice.

In conclusion, the results show that both groups of STs value their experiences of the AR-based projects. However, in the continuous development of AR-based projects within TE, there is a need for further exploration into the different constraints discussed above and how they can be mitigated. For example, how can the integration of theory and practice be further strengthened in contexts outside the tripartite collaboration? Also, in order to reach the full potential of an AR approach within pre-service TE, i.e. to further consolidate an integrated view of theory and practice and promote an ‘inquiry stance’ to the teaching profession (cf. Cochran-Smith et al. 2009; Niemi 2015; Ulvik and Riese 2016), we suggest that it is important to ensure that the

provision of scaffolding is balanced by enough opportunities for individual influence and agency (cf. Kosnik and Beck 2000). Still, this scaffolding needs to include further elements to familiarize students with AR principles throughout the different stages of the TE process than what is offered at present. In such ways, the projects can potentially meet the various developmental needs and interests among the STs and enable the development of a self-directed, inquiry-oriented stance (cf. Ferrance 2000; Heissenberger and Matischek-Jauk 2019; Smith and Sela 2005; Timperley et al. 2007).

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