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Firefighting training at a distance – a longitudinal study

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ABSTRACT
This article presents an analysis of a five-year study on the implementation of a technology-supported distance programme in Swedish firefighter training. Based on activity theory and four interview studies, the attention is directed to firefighter instructors’ perceptions and use of digital technologies with a focus on challenges, contradictions and changes. Two phases are identified, viz an implementation phase and a dissemination phase. During the implementation phase a clear contradiction emerges regarding how the object of the training should be interpreted, which results in the instructors responsible for the implementation reconsidering previous beliefs and, with the support of digital technologies, developing more theoretical and process-oriented approaches and improving the course design. However, during the dissemination phase, when all instructors are involved, a number of conflicts and dilemmas emerge, resulting in the changes achieved in the distance programme to some extent being normalised in the direction of the instructor-centred and exercise-oriented approaches of the campus programme. The article concludes with a discussion about contradictions as well as opportunities that may emerge during the implementation process of a vocational technology-supported distance programme.

Introduction
One consequence of the rapid development of information technologies is that technology-supported distance education is becoming an increasingly common study mode also in vocational training (Littlejohn and Pegler 2014). This article presents a summary analysis of a five-year study of the implementation of a technology-supported distance mode in firefighter training. Particular attention is given to the instructors’ perceptions and their use of digital technologies, and to the challenges, contradictions and changes that occurred during the implementation period. The analysis, the theoretical framework of which is activity theory.
(Engeström 1987, 2001), is based on four data collections and partial results have been previously reported (Holmgren 2012, 2013, 2015, 2016).

The literature reveals that research on the implementation of digital technologies and online-based distance modes in post-secondary education has typically been carried out in higher education, including vocational training, such as medical and teacher education (cf. Ertmer and Ottenbreit-Leftwich 2010; Pettersson and Olofsson 2013; Reid 2014). Usually, university students participating in distance education tend to have lower completion rates than those who attend face-to-face classes (Nistor and Neubauer 2010). However, educators can improve student engagement and completion rates through effective interventions (Yates, Brindley-Richards, and Thistoll 2014). In line with this, previous studies that compared online distance learning with traditional classroom learning in vocational education found no significant differences in achievement test scores (Chang et al. 2014; López Soblechero, González Gaya, and Hernández Ramírez 2014). However, studies on vocational training programmes, which involve extensive practical exercises and scenario training, seem to be rare (cf. Saud et al. 2011). The same also seems to apply to longitudinal studies into post-secondary education modes (cf. Pettersson and Olofsson 2013).

Teaching and learning in firefighter training seen from an instructor perspective can be described as a relatively unexplored area, while a few studies with a student perspective have been presented in recent years (cf. Blondin 2014; Göransson 2004). In particular, this seems to be the case for studies focused on training in online environments (cf. Maxfield and Fisher 2011). Given these observed gaps in knowledge as regards longitudinal studies of the implementation of ICT in vocational training in general, and firefighter training in particular, the study’s overall purpose is to complement previous research on technology-supported distance training in vocational education, by contributing knowledge acquired in the course of a long period of implementation involving a technology-supported distance programme. The relatively long time frame of the study made it possible for us to conduct several data collections and to explore on site the implementation in terms of change and sustainability over time and in relation to changes in the firefighter training context.

The specific aim of this study is to contribute knowledge about how instructors and their training practices are affected over time when an online distance mode is implemented in firefighter training in Sweden. From an instructor perspective, the following issues are addressed: (1) What challenges and contradictions can be identified in training practices when an online distance mode is implemented? (2) What changes in training practices can be identified during the implementation period, and what factors will contribute to or counteract these changes?

Below follows a survey of previous research considered relevant to the study’s research questions. The first section presents studies involving higher education and vocational training focused on expectations on teachers and teachers’ attitudes towards, and their perceptions and use of, ICT and the impact of the teacher
culture on ICT. The second section is focused on studies targeting changes and identified disagreements in the firefighter profession and firefighter training, chiefly in a British, Australian and Swedish context. These two sections are followed by a contextual description of Swedish firefighter training and the college under study.

**Teachers’ perceptions and use of ICT**

In studies of the implementation of digital technologies and distance training in higher education, the importance of analysing teachers’ perceptions and use of digital technologies in relation to their pedagogical and disciplinary competencies has been increasingly emphasised (Bibi, Markauskaite, and Ashe 2012; Mishra and Koehler 2006). Previous studies have chiefly been focused on a student perspective on learning from online teaching (Inayat et al. 2013; Maxfield and Fisher 2011; Northrup 2002; Swan 2001; Valtonen et al. 2012). Some of these studies highlight the importance of frequent communication and timely feedback from instructors to enhance the participants learning process in online education (Inayat et al. 2013; Northrup 2002).

A transition from face-to-face training to online training is often described as a shift from a teacher-centred to a learner-centred approach (Craig et al. 2008) in which the teacher is expected to be a facilitator who designs and organises an interactive learning environment (Goodyear and Retalis 2010; Laurillard 2012). In order to facilitate such a change, it is important that teachers’ pedagogical, digital and disciplinary knowledge be integrated and that their previous educational approach be the subject of reflection and review (Baran, Correia, and Thompson 2011; Redmond and Lock 2011).

Thus, studies have found that instead of using ICT-settings for developing learning environments that replace the teacher and make students learn from collaborating with each other, the real-time orchestration by instructors needs to be taken into account for increasing the learning potential (Hämäläinen and Oksanen 2012). The teacher’s support cannot be underestimated when it comes to tasks based on distance learning (Laine and Hämäläinen 2015). It seems that, in order to achieve quality in online learning, it is particularly important that educators adapt to a much more structured and deliberate teaching style (Innes, Mackay, and McCabe 2006).

Another aspect that is emphasised is the training culture and its co-creative functions (Reid 2014; Zhang 2010). For example, Zhang (2010) argues that implementation of digital technology never takes place in a vacuum but in a teaching and learning culture that houses values about education and occupation and regulatory power structures. In line with this, Ertmer and Ottenbreit-Leftwich (2010) and Reid (2014) show that teaching cultures can accommodate historically rooted approaches, which include what learning goals should be promoted and which methods and tools are considered appropriate. Furthermore, they also underline
that these approaches may constitute a cultural pressure that affects teachers’ willingness to integrate digital technology in teaching (Ertmer and Ottenbreit-Leftwich 2010). In vocational training programmes with extensive practical elements, such teaching culture influences seem to be even more pronounced, as it is a commonly held view among instructors that the learning of practical skills is best fostered through participation in physical environments under the supervision of instructors (Saud et al. 2011).

Implementation of technology-supported training may furthermore result in contradictions arising in the encounter between the ways in which teachers perceive, and act in, the learning environments and the opportunities for interaction and learning offered in digital learning environments (Blin and Munro 2008). These contradictions can either result in rejection, which means that training practices are not significantly affected, or in the emergence of an expansive learning manifesting itself in new course designs and new ways of teaching (Blin and Munro 2008). Conole (2010) argues that the barriers to this kind of change can be attributed to personal, organisational, pedagogical and technical aspects.

In light of these descriptions, Baran, Correia, and Thompson (2011) and Redmond and Lock (2011) demonstrate that shortcomings at the organisational level often result in the educational approaches developed in face-to-face environments being replicated in online environments. In other studies, it has been shown that teachers’ resistance can be attributed to perceptions of a lack of teaching control and confirmation (Murphy and Rodriguez-Manzanares 2008), but also that the use of digital technology may have a negative impact on training quality (Howard 2013) and pose a threat to the status of teachers (McQuiggan 2007).

Furthermore, some longitudinal studies reveal that online teaching may also be a catalyst for changes in teaching practices, e.g. in teacher education (Redmond 2011) and medical education (Pettersson and Olofsson 2013). A common finding in these studies is that teachers’ collegial reflection on the pedagogical approaches and the opportunities offered by digital technologies can contribute to improved training practices. These studies also emphasise the importance of longer longitudinal research projects which take into account how an implementation of digital technologies develop over time.

Thus, the importance of analysing instructors’ attitudes to teaching and learning, and an awareness of values and assumptions in the training culture seem to be aspects that are important to consider in analyses of implementation processes of digital technologies in educational contexts. Changes in policies and design in firefighter training are therefore an important starting point for increasing the understanding of such processes in terms of challenges, contradictions and changes.

**A profession and a vocational training in change**

Activity theory stresses the importance of including cultural and historical dimensions in analyses of collective work activities with a view to increasing the
understanding of challenges and changes studied (Engeström 2001). In recent decades, the firefighter profession has gradually changed from being a physical profession to being an increasingly white collar-like profession in many western countries (Childs 2005). This change is described in terms of professionals acting in a field of tension between the media image of the sacrificing firefighter and society’s demand for public services such as preventive and educational efforts in the local communities. This change increases the professionalisation requirements in areas such as leadership, critical reflection and information technology (Childs, Morris, and Ingham 2004).

However, there seems to be a lack of internal consensus within the profession about what constitutes the core of the profession (Baigent and Rolph 2003; Baigent et al. 2003; Dekker et al. 2008) and a lack of consensus between training institutions and emergency services about how training should be conducted (Häyrén Weinestål, Bondestam, and Berg 2011). Furthermore, it has been described how these different ideas are supported by two cultures, one formal and one informal (Baigent and Rolph 2003). In the formal culture, mainly represented by management staff, it is claimed that both the vocation and the training are developing in line with new policies on extended professional skills and increased gender equality and diversity. However, in the informal culture, which is predominantly represented by firefighters, there is an emphasis on preserving the professional values prevailing in their work teams. One example of such a value is the perception that smoke diving and firefighting work constitute the profession’s core duties (Baigent 2001; Mellström 2009), even though such work only occupies about 3% of the total working time (Scott 2005). Another key value is that men with physical strength are thought to be better suited as firefighters than women, and that trust in new recruits is largely dependent on their ability to adapt to the working teams’ informal culture (Baigent 2001).

These commonly held perceptions within the profession seem to be established early on in training. For example, Baigent and Rolph (2003) show that the ‘we and them’ rhetoric often encountered when staff talk about management is reproduced in rigidly structured training programmes, where the staff are mainly recruited from the emergency services. Similar views are found in a study by Häyrén Weinestål, Bondestam, and Berg (2011) on students’ transition from the training programme to the emergency services in the Swedish emergency services. Examples of such views are that students on the firefighter training programme are given incorrect information and that the training they receive is inadequate, which results in their colleagues in the emergency services having to ‘retrain them when they’re out in the real world’ (Häyrén Weinestål, Bondestam, and Berg 2011, 58).

However, Baigent and Rolph (2003) also recognise the existence of progressive training programmes, where the instructors are normally recruited from outside the emergency services. Their teaching emphasises the value of a development-oriented learning in order to broaden the students’ knowledge of both accident prevention and emergency response work.
Thus, according to these studies, the firefighter profession and firefighter training have been subject to new expectations from society in many countries and several changes have also been made in regard to policies and guidelines. It also seems that these changes have given rise to disagreements among various actors within the profession and the training, which we believe are important to address in the analysis performed in this study.

**Swedish firefighter training**

The Swedish SMO training programme (Accident Prevention Training Course) is a two-year tertiary firefighter programme that provides graduates with qualifications for employment in the emergency services. When it started in 2003, far-reaching changes had been made to the programme compared to the previous one (MSB 2001, 2002). On the basis of the amended legislation pertaining to the emergency services (SFS 2003:778), the intention of the supervising agency was that the SMO training programme should contribute to the development of improved social accident prevention, a broader recruitment base, a systematised organisational learning and a new set of basic values emphasising, for example, gender equality and diversity. As a result of the reforms, the training period was extended from 15 weeks to two years, the operationally oriented content was supplemented with a theoretical content focused on prevention, problem-based methods were introduced, recruitment criteria were changed and instructors with educational and professional backgrounds other than the emergency services were employed (MSB 2001, 2002). Taken together, these changes meant that the profession’s influence over the training programme decreased and was replaced by clearer instructions from the supervising government authority focused on a stronger scientific basis, process orientation, equality and diversity.

With the aim of strengthening diversity and flexibility in the programme, an online distance mode was implemented in 2008 as a complement to the campus mode (SOU 2007:31). With support from an e-learning centre and after receiving in-service training, a small group of instructors was given responsibility for the design and implementation of the distance mode. An expansion of the distance mode resulted in the majority of the instructors becoming involved in that mode 18 months later (Information provided by the college's administrative department).

At the studied college, including both campus and distance modes, 120 students are trained each year, 10–15% of whom are women. More than 20 regular instructors as well as many temporary instructors on loan from the emergency services are involved in the teaching. 15% of the instructors are women. The mean age of the tenured instructor is 47, and 53% have firefighter training while the rest have an academic degree. When the distance mode was introduced, there were no significant differences between the backgrounds of the distance and the campus instructors in terms of age, gender and levels of educational and professional experience. In the distance mode, most of the studies (75–80%) are carried out
at home where the students, with the support of digital technologies (Internet, LMS, etc.), complete the theoretical parts of the course (Information provided by the college’s administrative department).

In a typical 4–5-week course, course information and materials are distributed via the learning platform, and communication and collaboration takes place via asynchronous and synchronous forums, such as web-seminars, discussion forums, Q&A forums, chats, blogs, instant messages and email. Each course ends with one week of hands-on exercises and examination on campus. In the campus mode, by comparison, the practical and theoretical content is continuously integrated and distributed through instructor-led classroom instruction and practical exercises on the training grounds. (Personal communication with instructors at the college).

**Theoretical framework**

In order to understand long-term changes and developments, we use activity theory to analyse challenges and contradictions in firefighter training. The theory is based on the viewpoint that it is in object-oriented and mediated activities that humans develop their skills, their personalities and their awareness. It is also in these activities that humans can solve problems and create and use new cultural tools that may contribute to changed living conditions and life patterns (Sannino, Daniels, and Gutiérrez 2009). Given this starting point, the two study modes of the firefighter training programme, distance and campus, are regarded as goal-oriented training activities, which are affected and changing over time by the instructors’ uptake and use of digital tools.

Activities are described in terms of systems (Engeström 2001), where individuals, with the support of specific tools and in the context of certain rules, communities and principles of division of labour, are working together towards a collective goal. Figure 1 shows a model of the activity components and their relationships (Engeström 1987), which form the basis of the analysis.
Based on the activity theory’s emphasis on the potential of contradictions as drivers of change and development (Engeström 1987, 2001), attention has been directed to the contradictions generated in and between the two training modes of the firefighter training programme, distance and campus. They may, for example, appear in a component such as rules if there are conflicting guidelines for the activity, or between components, for example between the subject and the division of labour, if participants are assigned to perform tasks for which they do not have the required competence, or between several interacting activities if a common object is attributed different meanings in the various activities (cf. Engeström, Miettinen, and Punamäki 1999).

The term contradiction ‘refers to a unity of opposites, opposite forces or tendencies within such a moving system’ (Engeström and Sannino 2011, 370). However, this concept should not be equated or confused with terms such as conflict, dilemma, etc., which should be considered practice-related manifestations of contradictions. Further emphasised is the importance of analysing contradictions based on their historical context and from a systemic perspective, thus enhancing the understanding of their emergence. Since these aspects of the contradictions are not directly accessible in an empirical material but only their manifestations, Engeströms’ and Sanninos’ concept proposals shown in Table 1 were chosen as a starting point.

Despite the potential of contradictions to be a driving force for change and development in an activity, there is no guarantee that this will happen. Dilemmas, conflicts, etc., can be difficult to detect and define, and participants may feel uncomfortable openly acknowledging their existence (Engeström 1993; Murphy and Rodriguez-Manzanares 2008). These aspects have been important to consider in the analysis in order to increase the understanding of why changes occur in some circumstances but not in others.

### Design and methods

A longitudinal, comparative approach is used in this study, which means that challenges and changes over time in the distance mode were also analysed relative to instructors’ perceptions and actions in the established campus mode. It was

<table>
<thead>
<tr>
<th>Manifestations</th>
<th>Features</th>
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<tbody>
<tr>
<td>Double bind</td>
<td>Facing pressing and unacceptable alternatives in activity system</td>
</tr>
<tr>
<td></td>
<td>Resolution: practical transformation (going beyond words)</td>
</tr>
<tr>
<td>Critical conflict</td>
<td>Facing contradictory motives in social interaction, feeling violated or guilty</td>
</tr>
<tr>
<td></td>
<td>Resolution: finding new personal sense and negotiating a new meaning</td>
</tr>
<tr>
<td>Conflict</td>
<td>Arguing, criticising</td>
</tr>
<tr>
<td></td>
<td>Resolution: finding a compromise, submitting to authority or majority</td>
</tr>
<tr>
<td>Dilemma</td>
<td>Expression or exchange of incompatible evaluations</td>
</tr>
<tr>
<td></td>
<td>Resolution: denial, reformulation</td>
</tr>
</tbody>
</table>

Table 1. Manifestations of contradictions and their distinguishing features (Contradictions in Change Efforts), (Engeström and Sannino 2011, 375).
thus possible to identify and analyse contradictions and impact processes in the whole training programme.

The study is based on four data collections conducted in 2008–2012. The relatively long time frame is congruent with the theoretical framework (Engeström 1987, 2001) and with results from previous research demonstrating that the implementation of digital technology and distance training often takes the form of long and challenging change processes (Bound 2011; Mead Richardson 2013).

As shown in Figure 2, a total of 40 interviews with firefighter training instructors were carried out. These were supplemented by ongoing document collections and logbook notes. Data collections 1, 2 and 4 were primarily focused on the teaching and learning in the two study modes, while data collection 3 was aimed at instructors' perceptions of vocational learning.

The sample of informants was based on a quest for an equal distribution of the instructors' subject expertise, age, teaching experience and gender, which largely could be met. The goal to interview the instructors more than once could partially be accommodated, which meant that 10 informants were interviewed 2–4 times and 11 informants once. Semi-structured and thematised interview manuals were used (Kvale and Brinkman 2009), which had been designed in accordance with the study’s issues and theoretical framework. The interviews, which lasted between 55 and 110 min, were recorded with a digital recorder and transcribed.

As part of the data collections, training documents such as syllabuses and course guidelines were collected on an on-going basis and notes were taken during informal conversations with the training staff. The data were classified into categories such as semester, subject and course module and the processed material was then used as a basis for descriptions of the firefighter training and the training college, and as a background against which the instructors' comments and statements were analysed (Hammersley and Atkinson 2007).

With inspiration from Hjerm, Lindgren, and Nilsson (2014) and Kvale and Brinkman (2009), the processing and analysis of the interviews were conducted in a similar manner in all the data collections. Having been transcribed, the interviews were analysed in the framework of what is known as the ‘constant comparative technique/method’ (Hjerm, Lindgren, and Nilsson 2014). The texts were first categorised and coded provisionally and then in a more final form where several

<table>
<thead>
<tr>
<th>Data collection</th>
<th>Interviews</th>
<th>Document, logbook</th>
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<tbody>
<tr>
<td>1</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5</td>
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<td>3</td>
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<tr>
<td>4</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Total:</td>
<td>40 interviews</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2. Summary of the data collections.
categories with similar content could be merged (Kvale and Brinkman 2009). A mapping of these categories then provided a structure in which they could be grouped and combined into a number of empirically close themes which could be supported by interview quotes (Hjerm, Lindgren, and Nilsson 2014). These alternating comparisons of the text material went on until no new categories or themes could be identified, that is, until saturation was reached in the analysis (Kvale and Brinkman 2009).

The generated empirical themes were then analysed on the basis of activity theory, which meant that they were examined in relation to co-creative components such as instructors’ interpretations of the object, their use of tools, institutional rules, the instructor community and the principles for division of labour. The theory’s emphasis on the historical roots and contradictions of activities as a driving force for change meant that the emergence of the training programme as well as the changes that took place in it over time became important elements to consider in the analysis. The analysis model that was developed for the firefighter training context is shown in Figure 3.

As shown in Figure 3, the subjects in the training activity are the instructors, the object is the training of students in fire and rescue operations and accident prevention work, while the community consists of the instructors’ working teams. This activity is further seen as being mediated by a variety of tools such as rescue equipment and training grounds in both study modes, and digital platforms and the internet in the distance mode. Rules include explicit and implicit course guidelines and training structures, and the principles for division of labour regulate the instructors’ duties and responsibilities.
Findings and analysis

The analysis shows that two phases can be identified during the five-year study period: an implementation phase where the distance mode is introduced as an alternative study mode involving a few instructors and distance students, and a dissemination phase where, 18 months later, the distance mode is in place as a fully developed study mode in which several student groups and the majority of the instructors are involved. During these phases, several contradictions arise between the various components of the distance activity and between the distance activity and the campus activity. Furthermore, it is shown that these contradictions are handled differently during the two phases and that different conditions affect the instructors’ ability to deal with them. These different conditions seem to contribute greatly to the expansive learning that occurs during the implementation phase, while there is a clear trend towards a normalisation of the training practices during the dissemination phase. On the basis of the theoretical framework, a more detailed analysis is presented below.

Implementation phase

The online distance mode was not introduced in a vacuum (Reid 2014; Zhang 2010), but rather in a training course context that in recent years had been shaped in a field of tension between governmental change ambitions and the vocational profession’s influence on the firefighter training. The basic contradiction, in the interview material manifested as a conflict, is about different perceptions regarding what constitutes the training programmes’ principal mission and core.

As shown in Figure 4, a clear contradiction is found between the shared object of the emergency services and the previous training and the new SMO training programme (1a). This fundamental and historically rooted contradiction also emerges internally in the SMO training programme (1b) when it comes to how the extended and twofold object and the new rules (course guidelines) (2) should

Figure 4. Basic contradictions identified in the firefighter training.
be interpreted by the SMO training instructors. On the one side, in the previous training programme and the emergency services, there is a deeply rooted interpretation of the object that the firefighter training should be fire and rescue-oriented and adapted to the object and rules of the emergency services. As in previous studies on firefighter training (e.g. Baigent 2001), the analysis shows that the fire and rescue-oriented interpretations of the object and the rules are still dominant in the SMO training programme as a whole and advocated by instructors in the fire and rescue area, most of whom have a background in the emergency services. Moreover, in line with studies on the implementation of digital technology, the analysis shows that this dominant view of what firefighter training should be affects the instructors’ willingness to integrate digital technology into their teaching (cf. Ertmer and Ottenbreit-Leftwich 2010).

This is a practical training programme, they must be able to use the equipment and this calls for instructions and practice. It is important to get a sense of self-confidence and a knowledge of how the equipment and procedures work.

We need to spend more time on exercises in order to reach the same level of skills as those who work in emergency services.

On the opposite side, there is a more development-oriented interpretation that in order to be able to meet the increasing demands and complexity of the profession, the training programme must be broadened in the area of accident prevention. As also found by Baigent and Rolph (2003), this subordinate view is held by risk-and-safety instructors who have a background in other occupations and training programmes, and finds support in the new objectives and policies of the SMO training.

We must train thinking individuals, that is, individuals who have a basic knowledge and then get support to develop it further.

The most important thing in the learning process is to provide space for reflection and critical thinking. Students must be given the opportunity to analyse without any preconceptions about what is right or wrong. It is also important that everyone is given the opportunity to discuss things they have been thinking about.

The described contradictions regarding interpretations of the object and rules are common in the fire fighter profession and training institutions, as confirmed both in Swedish studies and in studies from other countries (Baigent et al. 2003; Häyrén Weinestål, Bondestam, and Berg 2011).

It is in this training context that the online distance mode is introduced, an intervention that must be considered revolutionary as it challenges the dominant view of the training as being situated in physical, equipment-rich and instructor-led environments (cf. Saud et al. 2011). Yet, in line with Conole’s (2010) argument that barrier-breaking relies on personal aspects, it turns out that the few instructors responsible for the implementation discover the possibilities of the distance mode rather than its limitations when it comes to changing the training practice in line with the object and rules of the SMO training.
We had a free hand, for better or worse. We knew what had worked and what hadn’t in the SMO training programme. Previously, things just rolled on and on for years, but when the distance mode was introduced it was an opportunity for a re-start based on the latest syllabus. We were considering the task structures and became convinced that it was PBL that we should use.

We saw the difficulties before we knew about the opportunities the technology could offer. How could we communicate and collaborate across the internet? [...] Plus our own scepticism, because I wanted to meet the students face-to-face. But the technology has made it possible to move the teaching out of the classrooms and into their homes, to students throughout the country.

Furthermore, the analysis of interviews shows that the introduction of the online distance mode can be described as a catalyst for reconsideration of previous training approaches (cf. Baran, Correia, and Thompson 2011; Redmond and Lock 2011) which resulted in a training mode that to a greater degree took into account the object and the rules of the SMO training programme. The opportunity to overcome the discrepancy between the object at the policy level and the implementation level thus seems to have outweighed the technological and pedagogical difficulties attributed to the distance mode. More concretely, the distance training programme was given a clearer process and active student focus than the campus programme, with improved problem-based tasks, added theoretical elements, such as exploratory tasks and report writing, and student reflection on their own learning with support of reflection diaries and blogging. The knowledge-imparting tradition that prevailed in the training programme was gradually replaced by a tutorial approach where students were given more responsibility for their own learning. This observation is consistent with research findings acknowledging that the shift from campus to distance nurtures a learner-centred approach (Goodyear and Retalis 2010; Laurillard 2012). Over time, the training materials and study assignments developed for the distance mode were gradually also introduced into the campus mode, which shows that the entire training programme was influenced by the developments that took place.

The changes in the distance mode have resulted in the campus mode now having better study assignments and now both study modes have an almost identical design. In addition, the distance students have greater energy and assume more responsibility than the campus students, something that we need to draw more conclusions from.

A number of factors can be identified in this phase, which taken together seem to contribute to the described development of the training practice:

- The basic contradictions between the emergency services/the previous training programme and the SMO training programme, and within the SMO training programme regarding the interpretations of the object and the rules, constitute the main incentive for these instructors to reconsider their former approaches and, with the support of digital technologies, to try to change their training practice (cf. Engeström, Miettinen, and Punamäki 1999).
- The implementation is instructor-driven (cf. Laurillard 2008).
• Time is allocated to instructors in order to reflect and plan, and their work is characterised by an exploratory approach (cf. Baran, Correia, and Thompson 2011).
• Pedagogical and technical support functions are available (cf. Redmond and Lock 2011).

**Dissemination phase**

The expansion of the online distance mode, which was fully implemented after 18 months, meant that the majority of the training instructors, regardless of their subject and teaching competence and experience of online teaching, were required to teach in both study modes. The interview material also reveals that the training support structures initially available were more or less discontinued. In this phase, as shown in Figure 5, a number of dilemmas and conflicts can be identified, some of which can be termed as contradictions.

*New tools for instruction* (1): A dilemma can be identified between the instructors (subjects) and the digital technology (tools). Some instructors lack familiarity with the digital technology tools and others a knowledge of teaching in digital learning environments. From an instructor perspective, the distance activity can be designated as a relatively uncertain and difficult training environment, where the instructors cannot rely on their previous teaching knowledge and skills (cf. Ertmer and Ottenbreit-Leftwich 2010; Redmond and Lock 2011).

From the very beginning, the problem was me – How will this end? Using headphones and a microphone speaking to someone who you can’t see.

I give the same messages to both groups, but why do the distance students listen to me and take responsibility for their preparations but not the campus students? Maybe I behave differently in the two groups, but I can't see it myself. How should I change? [...] I would like to find an answer to those questions.
Changed division of labour (2): Another dilemma concerns a prominent view among the instructors, namely that, compared to virtual environments, physical training environments offer much better conditions for imparting knowledge, checking the students’ attention and progression and receiving confirmation of the quality of the training through verbal and visual clues (cf. Murphy and Rodriguez-Manzanares 2008). The fact that the instructors’ opportunities for face-to-face teaching are limited in the distance mode and replaced with digitalised training materials and that instructors and students are reduced to names on the screen represent a dilemma in relation to their views of how firefighter training should be conducted. This dilemma can be regarded as a contradiction between a historically grounded approach to training, focused on instructor-led knowledge imparting and control, and an alternative approach to the division of labour, in which instructors are expected to facilitate and support the students’ learning (Goodyear and Retalis 2010; Laurillard 2012).

I prefer a physical classroom where I have a better control of each individual.
I get a completely different kind of feedback when I have the campus group. I get quick responses and it is easier to see by the students’ behaviour what they think about the teaching.

Changed rules (3): A third and more conflict-like contradiction concerns the expectations that the instructors perceive are made of them in the online training activity. In the campus activity they still have more opportunities to act in accordance with experiential-based and practice-oriented guidelines and routines deeply rooted in the firefighter profession, while in the online distance activity they are, to a greater extent, expected to follow the new more academised course guidelines with extended theoretical elements and process orientation. This contradiction can be understood first and foremost in relation to changes to the rules (new vs. old course guidelines).

Watching a screen and talking and writing to a lot of people that I can’t see – it does not feel right for me, I do not feel at home in this environment.
I’m afraid we are too focused on theory and educational credits instead of practical matters.

From an instructor perspective, the transition from the campus activity to the distance activity can be described as follows:

• From a high-status work regulated by professional routines on the training grounds to computerised desk work regulated by more academised guidelines (cf. Saud et al. 2011).
• From an essentially oral-based training tradition with the instructors at the centre to a largely writing-oriented, less hierarchically organised training.
• From a position where occupational and practical skills constitute the most important resources to a position where theory-based knowledge and approaches emerge as important complementary assets (cf. Childs, Morris, and Ingham 2004).
From an instructor perspective, this transition can thus be seen as a professional degradation where they have to leave their high-status expert role for a precarious instructor role where other skills are in demand (cf. Baigent et al. 2003; Childs 2005).

Changing training object (4): To conclude, the basic and fundamental contradiction regarding the object that was identified during the implementation phase between the previous training programme/emergency services and the SMO training programme, also emerges clearly in the dissemination phase. This contradiction is reflected in the frank rhetoric common among many instructors claiming that the SMO training is failing to adapt to the traditional demands of the firefighter profession, and that an increasingly theoretical and digital training environment makes this adaption even more difficult (cf. Baran, Correia, and Thompson 2011; Häyrén Weinestål, Bondestam, and Berg 2011).

I think the demands are too high in the theoretical parts. I’m sorry to say that we have a lot of academics here who require the students to write academic reports, but our students are not training to be academics. They lose practical training opportunities, which they need. They have to practice until their actions become second nature to them.

We need to devote more time to practical exercises so that the students can reach the same level as those who work in the emergency services.

In the light of these identified contradictions, the instructors’ actions in the distance activity may be described as silent resistance (cf. Murphy and Rodriguez-Manzanares 2008), mainly manifested in the way they prioritise the campus training over the distance training. However, the instructors’ limited presence in the online distance training is to some extent compensated for by their more active participation in the exercise meetings. Their obvious prioritisation of the practical elements of the training suggests that the previous object with its roots in the emergency services still has a major impact on the training culture and the instructors’ way of acting (cf. Ertmer and Ottenbreit-Leftwich 2010; Reid 2014). Overall, the following key factors can be identified in the dissemination phase, which seem to contribute to a normalisation of the instructors’ actions in the distance activity towards the established training approaches in the campus activity:

- The fundamental contradiction regarding the object of the SMO training programme has not resulted in a common view among the instructors or any lasting changes in the training practice, despite interventions from the supervising agency such as new policies and guidelines. The introduction of the technology-supported distance programme, with its stronger emphasis on theory, process and accident prevention work, has rather accentuated this contradiction over time, suggesting that the profession still has a strong influence over the firefighter programme.
- There is a shift in the instructor-driven and pedagogical development-oriented approach that characterises the implementation phase towards a top-down direction in the dissemination phase, at the same time as the educational support resources decrease. These changes contribute to a decrease
in the instructors’ participation in the development of the distance mode and at the same time they are not given the same support to develop their own pedagogical digital competence.

- The instructors’ lack of experience in online teaching and their lack of control and confirmation create dilemmas resulting in the distance mode being perceived as a precarious and inexpedient training mode.

The impact of the implementation on the training programme

Given the normalisation that occurs in the distance mode during the dissemination phase, the obvious question is whether the implementation over time has an impact on the training programme as a whole. The following changes can be identified: (1) The uptake and use of digital technologies as new training tools in the distance activity are to some extent spread to the campus activity, which means that all instructors and students have access to additional tools for communication, interaction and information searches. This means increased flexibility for students and instructors in time and space and that more sources of knowledge are made available. (2) The use of digital technologies provide greater transparency when it comes to training content, design and methods, which contributes to a spread of good practice throughout the training programme. For example, problem-based and process-oriented tasks and new course designs created for the distance programme are gradually used also in the campus programme. (3) The implementation of the distance programme contributes to changes in the division of labour whereby the instructors are given overall responsibility for both study modes, which seems to result in extended discussions about pedagogical issues and how the twofold object should be interpreted. The presence of these discussions show that the introduction of technology-supported distance education has the potential to transform the pedagogical orientation also in training programmes with strong roots in the profession.

Conclusions and implications

This study has shown that the implementation of a distance mode and its possibilities to function as a catalyst for changes in teaching practices, as Redmond (2011) and Pettersson and Olofsson (2013) claim, is not a straightforward process. The potential for a distance mode to transform teaching practices cannot be reduced either to promises of changes that technology may provide or to a few teachers’ engagement. Instead, using a longitudinal approach and activity theory, we have shown that the implementation relies on an ongoing process of teachers’ negotiations of dilemmas and conflicts that emerge when new technology is implemented in a vocational training culture with fixed perceptions of how students are best educated.
The analysis has made it possible to identify conflicts and dilemmas, related both to the object of the firefighter training and to its rules and division of labour. Some of them have in the implementation phase been shown to be catalysts for change in pedagogical approaches and training practices, while others, in the dissemination phase, have counteracted and normalised already achieved changes (cf. Blin and Munro 2008; Pettersson and Olofsson 2013; Redmond 2011). A long-term perspective that also includes the historical emergence of the training programme and the training culture can therefore be recommended in order to increase the understanding of the opportunities and difficulties associated with the implementation of technology-supported distance programmes in vocational training.

To sum up, three main themes with implications for vocational training emerge from the analysis. First, in light of the findings in the first part of the analysis, it can be concluded that while an implementation of a technology-supported distance programme in vocational training has the potential to visualise inherent contradictions, it can also be a catalyst which can contribute to changes and improvements in training practices. In addition, as shown in this study, it may gradually lead to new interpretations of the expected learning outcomes, which in turn enables improved course designs, tasks and tutoring approaches with the support of digital technologies. Thus, the overall picture indicates that implementation of a distance mode may result in a restart for a training programme in which the objectives and guidelines are given a clearer impact on the training. However, in order to create sustainability in the progress achieved long-term pedagogical support structures are needed (Pettersson and Olofsson 2013; Redmond 2011).

Second, given the results of the second part of the analysis, it can be concluded that the profession and the training culture have a strong influence on the instructors’ perceptions and actions (cf. Baigent 2001; Reid 2014; Zhang 2010). In this study, the dissemination phase seems to be a particularly critical point, where the achieved changes in course guidelines and pedagogical approaches are confronted with the profession-oriented conceptions of training dominant in this training programme. Thus, the results seem to indicate that implementation and development work too dependent on specific persons is risky and may lead to a number of contradictions arising in the course of subsequent dissemination phases. The absence of pedagogical support during the dissemination phase also seems to contribute to a reinforcement of certain contradictions (e.g. traditional instructor-led teaching vs. tutorial approaches in the digital environment). In order to minimise the dilemmas and conflicts shown in this study it is recommended that implementation of technology-supported vocational training should begin with a thorough analysis of existing interpretations of the objectives and guidelines, and also of other assumptions and approaches underlying the training. Such an analysis, in which the instructors’ participation must be ensured, is likely to have a significant potential for identifying both opportunities and obstacles for a successful implementation.
Finally, it can be noted that the implementation of the distance mode to some degree leaves a lasting impact on the firefighter training as a whole. Increased transparency and shared responsibility for both study modes means that good training examples can be disseminated and that pedagogical development issues are given increased attention. At the same time, however, it is apparent that a lot of work remains to be done in order to overcome the educational conflicts and technology-related dilemmas identified in this study. This means that the professional-oriented perceptions of the training objectives need to be processed and that the opportunities of the digital learning environment have to be identified in relation to the educational needs. To facilitate this development, it is recommended that vocational instructors’ influence be ensured regarding how the distance and the on-campus modes should be designed, that the instructors be given access to ongoing in-service training and mentoring, and that the principles for the recruitment of instructors be reviewed. We would like to conclude with a call for further use of theory-based longitudinal designs that can capture changes in teaching practices which highlight both inhibitory and supportive processes of the implementation of technology-supported vocational training.

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