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Preparations for practical exercises in vocational education: Can ICT-based distance instruction be an alternative to face-to-face instruction? An empirical contribution

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Abstract

In this article about preparation for practical exercises in firefighter education, comparisons were made between ICT-supported preparation in distance education and preparation supported by face-to-face instruction in on-campus education, with regard to their impact on students’ reflection and learning processes and implementation of exercises. Data was collected in two studies through interviews with students and instructors from both educations. The results showed that distance students with ICT-supported preparation took a greater responsibility for their studies and reflected more on course content and their own learning, compared to students with face-to-face instruction as preparation. Distance students were also better prepared for exercises on campus. However, interaction and collaboration occurred to a lesser degree among distance students.

1. Introduction

This paper is about preparation for and implementation of practical exercises in firefighter education. In the late 1900s, the purpose of firefighter education was primarily to develop student firefighters’ operational competence (Childs, 2005; Wilson, 2000 a, b). The accelerating pace of change in society with technology development, environmental responsibility, and demands for emergency preparedness, together with increasingly complex emergencies, has resulted in increased professionalization requirements in recent years. (Baigent et al., 2003; Childs, 2005). As a consequence of this development, it has been stressed that the content and form of firefighter education must change. In the preface to Baigent et al., (2003) the following statement is made:

The role of firefighter has changed dramatically over the past few years and will continue to do so as the modernizations agenda is developed. This will have implications for everything associated with the service and in particular in relation to the type and delivery of basic training. The wider role of rescue work and the demands of community fire safety require skills that need to be taught in a different manner to that of firefighting. All of this will require the initial training to be delivered in a manner that meets the new agenda. (p. 4)
In order to meet new professional requirements, a new two-year firefighter education SMO (Accident Prevention Training Course) started in 2003 in Sweden, which replaced the previous short-term courses. The Swedish state is via MSB (the Swedish Civil Contingencies Agency) responsible for the education, while responsibility for emergency services lies with the municipalities. About 60% of the education consists of theory and 40% of practice. In education, the importance of theoretical and scientific foundation is emphasized and skills considered necessary for students to develop comprise collaboration, problem solving, reflection and information management. Since the start of SMO in 2003, the instruction is dominated by PBL, problem-based learning, where the aim is that the learning process should be guided by the learners and knowledge developed in collaboration with others (MSB, 2001). In order to develop more flexible forms of study and to recruit new student groups, a distance education started in 2008. MSB was therefore faced with another challenge, namely to develop an ICT-based learning environment that could replace the face-to-face instruction given on campus.

On-campus education and distance education have the same content, which is divided into two themes - Rescue, which includes the handling of tools and practical applications and Risk and Security, which deals with theory, analysis and assessment of risks (MSB, 2002). The designs of the two educations are nevertheless different, as shown in table 1.

<table>
<thead>
<tr>
<th>Content</th>
<th>On-campus education</th>
<th>Distance education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
<td>Theoretical studies integrated with practical exercises on campus.</td>
<td>Theoretical studies with support of ICT, 75% of course time.</td>
</tr>
<tr>
<td>Practice</td>
<td>Minor and major practical exercises and self-training on campus.</td>
<td>Practical exercises and self-training concentrated in a few campus meetings, representing 20-25% of course time.</td>
</tr>
</tbody>
</table>

Based on a sociocultural perspective on learning, the concepts mediating tools, communication and interaction are used in this paper, in order to understand the impact that the use of ICT tools has on the preparation process in distance education. According to this perspective the reality is mediated through linguistic and physical tools, which help humans to understand and manage their environment. By using the tools in different situations and environments, the individual becomes involved in the collective knowledge development that is continuously taking place in society and its various practices. Access to the linguistic tools means that the world may be termed and analyzed, but also that humans can communicate knowledge and experiences with each other. Participation in social practices in terms of communication and interaction thus becomes an important basis for human thinking and learning (Vygotsky, 1978, 1986, Wertsch, 1991). In this study, ICT technologies used in distance education are seen as mediating tools aimed at supporting students in their learning processes. Interactions between tools and actors (instructors and students), as well as the communication enabled through these tools, thus constitute an important starting point. In light of this contextual description, the purpose of this article is to compare two forms of support for learning, ICT and face-to-face supported respectively, when students are preparing for practice, in terms of how the learning process and implementation of practical exercises are affected. Particular attention is given to the following questions:

- How is students’ learning process affected by the support given during the preparation - ICT-supported compared to face-to-face supported?
- What impact has the respective way of preparation on the implementation of practical exercise?

2. Previous research

A review of current research concerning distance learning and use of digital technologies shows few studies of firefighter education, but more in other areas of education. In a study in American Fire Science program, Collins and Pascarella (2003) found that distance students who received instruction via a two-way interactive tele-course demonstrated equivalent learning to that of students on campus. Similar results are also shown in many other studies.
where no significant differences in learning outcomes are demonstrated to be due to delivery modes (see for example within higher education - Abdous & Yoshimura, 2010: Tucker, 2001, nursing education - Campbell et al., 2006 and education of business and management - Larson & Sung, 2009). These results were also supported in a meta-analysis of distance education studies from 1985 to 2002 (Bernard et al. 2004) where they found no significant difference in learning outcomes compared to face-to-face instruction. However, the analysis showed that the use of asynchronous applications were more favourable for student achievement than classroom teaching. This study can be compared to a recent meta-analysis of research studies of learning from 1996 to 2008 (Means et al., 2009), which indicated that distance students on average performed better than campus students. Similar results are also presented in a study of teacher education by Levenberg and Caspia (2010). However, most studies thus appear to conclude that no significant difference in learning outcomes can be demonstrated to be due to delivery modes. These findings have also become known as “the no significant difference” phenomenon (Russel, 1999). A study of continuing education with emergency medical technicians – EMTs, (Jerin & Rea, 2005) showed that web-based instruction supported by digital images, video and audio finds high acceptance among the participants. The advantages over traditional teaching included the greater flexibility and multiple opportunities for review, but the disadvantages were a lower degree of interpersonal interaction and lack of immediate feedback.

The importance of asynchronous applications is highlighted in many studies. Maxfield’s study (2009) of asynchronous online learning in American rescue training showed that written communication was an effective tool for reflection and learning. Similar results were also presented in other studies within medical education (Lillis et al. 2010), and higher education (Hrastinski, 2008; Meyer, 2003). For example, Hrastinski (2008) argues that asynchronous e-learning is particularly useful when working with complex issues and when students are expected to reflect on specific course topics. However, Garrison and Cleveland-Innes (2005) showed that interaction in asynchronous learning environments was in need of structure and leadership to promote learners’ deep learning. Rovai (2002) also stated that the learner’s perceived cognitive learning has a clear connection with a sense of community.

In connection with the development of e-learning software for an emergency response simulation, Taber (2008) demonstrated the importance of ICT-tools supporting both collaboration and reflection. According to the author, access to material resources, to peers and experts, feedback and relevant training based on real-world situations, contribute to the development of critical active learning. Similarly, Salmon (2002) concludes that promoting reflection on practice is viable and beneficial in the online environment. Chen et al. (2009) found that the main factor affecting reflection levels was high level prompts followed by high quality observation.

Portfolio and journal writing as support for reflection and learning have been examined in many studies (e.g. Beecher et al., 1997; Pearson & Heywood, 2004, Francis et al., 1998; Williams & Wessel, 2004). For example, Beecher et al., (1997) and Francis et al., (1998) reported that use of portfolio developed participants’ reflection on complexity and development needs of their own practice. Studies of digital reflection diaries also show that they may be an important support for reflection and learning (e.g. Butler et al., 2010; Gleaves et al., 2007). For example Butler et al. (2010), suggest that the diary as a tool stimulates students’ reflection on both previous experience and their own learning.

3. Methods

This article is based on two studies conducted in 2008 and 2010. The first one was conducted at the end of semester one and the other at the end of the fourth semester, when the students have completed their studies. In the first study, data was collected through semi-structured interviews with 6 instructors and 4 students from each form of education, on-campus and distance, in total 14 interviews. Three of the instructors were involved in distance education and the remaining three in on-campus education. The selection of instructors was based on the criterion that they should have experiences from both types of education, which in the end resulted in five of six instructors being able to meet this criterion. The selection of students was based on voluntary participation. We searched for four students from each form of education and those who were interviewed were those who first signed up. In the second study, follow-up interviews were carried out with 12 of the previous 14 informants. However, one teacher
and one campus student could not participate. All interviews were recorded and transcribed and then analyzed on the basis of the socio-cultural concepts of mediating tools, communication and interaction.

4. Results

N In order to create understanding of the different instruction approaches that are realized in the two courses, the prevailing approaches to learning in the respective education are presented initially. This is followed by descriptions of tools and resources for learning used in the respective education, and how they are valued from a learning perspective. Finally, the impact of the concept of distance learning preparation on the implementation of the exercise is shown by assessments made by instructors with experience from both types of education.

4.1. Beliefs about learning and instruction

Instructors with experience from both education forms describe the prevailing conception of learning and instruction in on-campus education, that learning is best promoted when the content is conveyed and explained to the students. Proven experience and tradition are the basis for what is considered right and wrong, and it also characterizes the instruction being given. This view of learning and instruction is regarded as particularly dominant in practically oriented rescue courses.

Culture is like this. An instructor here must be an older man who has worked for 20 years in emergency services, and tells students how it is, and then it will be right (Campus instructor).

Old traditional intermediary role, there is much talk, but still it’s reading and lectures. (...) The origin is in ‘the doers’ in emergency services. It is more difficult to discuss doing things differently, to reflect is more difficult (Campus instructor).

However, interviews show that this traditional approach to learning in on-campus education is challenged when the planning for distance education begins. Planning instructors realized from the beginning that it was important "not only to transfer the regular approach to distance education." Rather they considered that they now had an opportunity to use past experiences to develop the education through a better problem-based profile and with a form of instruction that takes more account of the overall learning objectives. In distance education, they also saw the possibility to connect theoretical aspects to concrete practices in distance students’ hometowns.

We were given a free hand, for better or worse. We knew what worked and what did not work, in the past SMO. There was a new start opportunity. Here at school, the old way has just rolled on, but now there was an opportunity for a new start based on the curriculum. We reflected on a discussion and task approach and became more convinced that it was the PBL that we should run, almost more in its original form in the distance education (Distance instructor).

How to use the fact that they actually are at home, school is after all a fiction of reality. What’s it like at home with accidents, risks and more. We have tried to think in new ways (Distance instructor).

However, the distance instructors were initially highly concerned about the lack of communication at a distance. The instructors’ lack of ICT skills contributed to doubts about the ability to communicate online.

The use of PBL was our starting point but before we knew about the technology’s potential we saw problems – how to communicate and collaborate? Plus my own skepticism, I wanted to meet my students. But technology has made it possible to move out from our classrooms to the students’ home, one student in Ystad and the other in Haparanda (Distance instructor).
Distrust towards educating firefighters at a distance was also a widespread opinion within the firefighter education. This meant increased demands on distance instructors to create a course that could compete with the on-campus education.

_I have even said that the distance students must be better because they are thoroughly checked. You can’t do that, that is, do your studies at a distance, is a common view among campus instructors and leaders. Therefore, we are demanding a little more (Distance instructor)._}

### 4.2. Tools and resources in support of learning

In interviews, instructors describe that prevailing beliefs are realized in a traditional classroom preparation on campus. Instructors skilled in their subject give lectures to classes and the communication is characterized by limited scope for dialogue and students’ questions. The students work extensively together with the tasks during formal seminars and informal meetings, and in support they have the library, the Internet and course information on the course platform. The students present their tasks orally in the classroom and in written reports, if appropriate. The instructor is available as a resource, when students need support in their work. Overall, the instruction is characterized by oral communication, both during lessons and also during the implementation and examination of tasks.

In distance education, the course content is presented on the course platform through films, slides, written instructions and filmed lectures. Each student is responsible for the searching and processing of the course material. Tasks are carried out by a combination of individual work, virtual group seminars and in written forums. The instructor participates as support for the group in virtual seminars, in forums and through telephone contact. The examination of tasks is primarily written, but also to some extent oral. The instructor also participates as a support resource by providing individual written feedback on students’ writing in their process journals. Written communication is thus given much larger space in the distance education compared to that on campus. The different instruction approaches on campus and in distance education are summarized in the table below:

<table>
<thead>
<tr>
<th>Aspects of learning and instruction</th>
<th>On-campus education</th>
<th>Distance education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution</td>
<td>Lectures / lessons with the whole class</td>
<td>Online teaching materials</td>
</tr>
<tr>
<td>Learning activities</td>
<td>Formal and informal collaboration in the base group on campus</td>
<td>Formal and informal collaboration in virtual and written forums, large proportion of individual work. Group work is carried out via virtual weekly meetings with instructors, and through individual work.</td>
</tr>
<tr>
<td>Tools and resources for learning</td>
<td>Base group, study rooms, library, the Internet, course information online. Informal communication with instructors on campus.</td>
<td>Base group, virtual meeting rooms, course platform with online instructional videos, slide shows, instructional materials, online literature. Discussion forums, process journal.</td>
</tr>
<tr>
<td>Examination</td>
<td>Orally, report writing</td>
<td>Report writing, orally</td>
</tr>
</tbody>
</table>

### 4.3 Evaluation of tools and resources in support of learning

Interviews with campus students and instructors show that face-to-face communication as a tool for learning is highly valued among them. During lectures by instructors skilled in their subject, questions can be answered...
immediately and ambiguities can be clarified through explanations and exemplifications. The value of these explanatory lectures is expressed in the following quotations:

They (distance students) probably have to read all the information for themselves. We get it told to us, or via other media. A lot more discipline, they need to understand it by themselves instead of by us, who get it explained (Campus student).

It’s an advantage that the students are here. Sitting behind a webcam is not as personal. You say so much with the body that is not visible on camera, it gives a better presence to the benefit of learning (Campus instructor).

Campus groups work to a large extent together in both group work and individual tasks and they often take informal contact with the instructor to get answers to their questions. Communication and interaction in the group are thereby regarded as essential to supporting learning and also important to practise, because firefighters’ work involves a lot of collaboration in groups.

It is much easier if you are in a group when you have to solve a problem. Everyone sees it differently, and if we put our heads together, we get a little different solution. We will not get stuck in the same ruts as you do if you are sitting alone (Campus student).

There is more teamwork on campus. Learning in groups is very important because the firefighter profession is a group-based profession. They learn from each other, those who are more able teach those who are less capable (Campus instructor).

Lectures, teachers’ verbal instructions and answers to student questions are in addition to literature studies and seminar discussions important tools and resources for on-campus students’ learning in formal education. In addition to this, on-campus students also highly value the informal learning that occurs through discussions and reflections on shared experiences during their leisure time.

The advantage of the campus is our access to the stuff and closeness to friends – the social atmosphere. You learn a lot in breaks too, during discussions, when we question each other and remind each other of shared experiences (Campus student).

In contrast to this, table 3 below summarizes distance students’ and instructors’ views on obstacles and opportunities regarding ICT – supported preparation.
Table 3. Summary of distance students’ and instructors’ prominent views on obstacles and opportunities for learning through ICT-supported preparation

<table>
<thead>
<tr>
<th>ICT-tools</th>
<th>Obstacles Students</th>
<th>Obstacles Instructors</th>
<th>Opportunities Students</th>
<th>Opportunities Instructors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web-based course material:</td>
<td>Limited materials</td>
<td>Different prerequisites among students to benefit from written materials</td>
<td>Extensive and repeated interaction with course material</td>
<td>Extensive and repeated interaction with course material</td>
</tr>
<tr>
<td>instructional videos, slide shows,</td>
<td>Less opportunity to communicate the content</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lectures, links, etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virtual seminars: audio and video</td>
<td>Limited space for social engagement</td>
<td></td>
<td>Goal and knowledge oriented and time-efficient</td>
<td></td>
</tr>
<tr>
<td>Discussion Forum: written discussion</td>
<td>Writing skills critical for the level of activity</td>
<td>Writing skills critical for the level of activity</td>
<td>Encouraging a reflective approach</td>
<td>Encouraging a reflective approach</td>
</tr>
<tr>
<td></td>
<td>Delayed communication, interpretation difficulties reduce motivation</td>
<td>Delayed communication reduces motivation, (other tools are used e.g. phone, MSN, email)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Seen as artificial communication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process journal: student document with feedback</td>
<td>Time consuming, reduces the motivation</td>
<td></td>
<td>The individual student’s learning process becomes visible</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Seen as artificial communication</td>
<td></td>
<td>Support for structuring studies</td>
<td>Support for structuring studies</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stimulates a reflective approach</td>
<td>Stimulates a reflective approach</td>
</tr>
</tbody>
</table>

Table 3 shows that distance instructors with experiences from both education forms believe that the ways in which these ICT-tools are used contributes significantly to students’ reflection on course content and on their own learning process. Since the content is not provided in the same manner as in the on-campus education, but is subjected to the students’ own examination, it increases the students’ responsibility for considering and understanding the content in relation to their own learning.

*In distance education the process-oriented guidelines are followed to a greater extent than on campus. We give students a clearer responsibility that they take and we create a learning environment that supports students in their study routines and learning, which together is a pedagogical advantage (Distance instructor).*
Some instructors even claim that this learning and instruction approach contributes to a higher quality of the student’s learning processes, compared to those on campus, as shown in the following quotation:

*Distance students read more than regular students do, which leads to higher quality. Regular students read less and trust that the teachers give them the truth (Distance instructor).*

Moreover, table 3 illustrates that two dominant views are prominent among distance students. A group of students who largely share the instructors’ views, but also a group that regard many of the activities that take place in various forums as ineffective and artificial. They rather prefer more directly conveyed instructions, and less of problem-based and written activities.

*Provided material is much better than the PBL-driven, then we must work hard to be on the Internet and look for materials. Find info, we can, and most important must surely be that we reach the course objectives (Distance student).*

Many distance students also express their wish for more social interaction in their groups.

*I would welcome more collaboration in my group but team spirit is difficult to create online because not all give priority to this (Distance student).*

### 4.4 Implementation of practical exercises

Do the two courses’ different ways to prepare students, face-to-face or with support of ICT, result in visible differences in their implementation of exercises? How can the process of practical exercises be described and how do the students perform? The instructors’ overall assessment is that no major differences exist between student groups’ physical performance. However, they describe that instructions and practical applications can be implemented in less time with the distance group.

*Theory preparation and pre-understanding is very important. You can start on a completely another level compared to regular students, where you must start from scratch. Theory lessons and teaching of practical exercises are much more efficient, just short repetitions are required. There are examples where the theory part of extrication from the car took 10 minutes with distance students and 80 minutes with campus students (Distance instructor).*

Distance students’ higher pre-understanding also means that fewer basic questions are asked and that more complex issues and knowledge can be dealt with. A campus instructor with experience in both educations makes the following statement.

*No significant difference between groups in physical performance, but the discussions are often more advanced among distance students (Campus instructor).*

### 5. Discussion and conclusion

The results show that the specific conditions of distance education resulted in an ICT-based distance education concept, challenging the traditional face-to-face instruction in firefighter education. Simply put, the course content supported by various ICT technologies was repackaged and given a different form in the distance education, which led to the following changes in the preparation process:

- The responsibility for learning shifts from teacher to student. The content is not conveyed and explained in the same way as in on-campus education, but is to a greater extent the subject of the student’s own examination and reflection. This means that distance students to a higher degree than campus students use and develop skills like searching, examining and reflecting on the course content. Similarly other researchers (Salmon, 2002, Taber, 2008) show that an online environment with supportive ICT tools can contribute to reflective learning.
- Written communication, between teacher and student and between students, is given a larger role in the learning process in distance education, compare to on-campus education, which is dominated by oral communication. Due
to this distance approach two consequences for the learning process can be identified. Firstly, it means that the individual student’s learning process becomes more visible than within on-campus education. The instructor can then provide feedback that is more suited to the needs of the individual student. Secondly, the written communication, which is often asynchronous, means that the student is given time and is encouraged to reflect on questions, answers and comments from teachers and other students. These advantages of asynchronous communication are also confirmed in many other studies (Maxfield, 2009, Lillis et al. 2010, Hrastinski, 2008). However, the emphasis on written communication and interaction via ICT tools is regarded by a student group as a barrier to learning through the effects of delay, interpretation difficulties of instructions and postings, and problems with formulating themselves in writing. The former problem is also described by Jerin & Rea (2005).

- Communication and interaction in the ICT forums are characterized by a clear focus on course content. However, this study shows that social interaction and group participation were not developed in the same way in distance groups with ICT-supported preparation as in campus groups with face-to-face preparation. The lack of direct and close communication resulted in a lower degree of interaction and collaboration in distance groups. It may be assumed that this lack has had a negative impact on students’ learning, because other studies show the importance of collaboration (Taber, 2008) and sense of community (Rovai, 2002) to benefit learning.

In addition to this, there were beliefs among instructors that distance students were better prepared for the practical exercises. No differences in students’ practical performance were observed, but distance students demonstrated a greater contextual understanding of the exercises. This meant that the exercises could be implemented more efficiently and with more in-depth communication about exercise content. These results therefore support previous studies showing that ICT-supported distance education, in comparison with face-to-face instruction, can provide higher learning outcomes (ct Levenberg & Caspia 2010, Means et al., 2009).

An analysis of the results reveals that several factors may have contributed to this outcome. Firstly, it may be due to the fact that the distance students read all the theory in a concentrated form and that it precedes the practical exercises? Secondly, it may be due to the mediating function of ICT tools providing better support for students’ learning than face-to-face instruction? Thirdly, it may be because the distance instructors spent much time and effort on developing distance education with the goal that it would be just as good as the on-campus education? It is probable that the result can be seen as a combination of these factors, where the shift in learning responsibility from instructor to student plays a significant role. However, for greater understanding of this issue, further research is recommended.

At the start of distance education, it can be concluded that pedagogical considerations concerning the conditions and forms of study preceded the search for suitable ICT solutions. Pedagogical considerations thus came to influence what ICT tools could be used and how they could be designed, in order to best support the students in their preparation. It is likely that the planning and implementation process has thus contributed to strengthening the mediating function of ICT tools.

In conclusion, this study shows that distance education as a phenomenon is something that greatly challenges the prevailing beliefs about learning, in educational institutions as well as among students and instructors. This is perhaps true especially in practically oriented vocational education such as firefighter education, where the view of learning seems to be characterized by the fact that it primarily occurs in a practice of making? However, this study shows, despite several limitations, that a well-designed ICT-based preparation process in distance education can be a great alternative to face-to-face instruction.
References


