Tuulikki Keskitalo

Developing a Pedagogical Model for Simulation-based Healthcare Education

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ABSTRACT

Tuulikki Keskitalo
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The purpose of my research is to facilitate healthcare education in simulation-based learning environments (SBLEs). The specific aim of the present study is to give examples of how simulation-based education can be applied in pedagogically appropriate ways by developing a pedagogical model. Multiple research questions were set to meet this goal. The study uses design-based research (DBR) and case study approaches, which provided an opportunity to answer the research questions as well as develop theory and practice. Altogether the study involved 21 facilitators and 136 students. In the first sub-study, eight facilitators were interviewed in order to find out their approaches to teaching and learning and the educational tools they used. The second sub-study examined 97 healthcare students' expectations of simulation-based learning through questionnaires. In addition, data were collected during two case studies. In both case studies, the students trained within SBLEs on scenarios on a given topic. Data were collected through pre- and post-questionnaires, observations and field notes, video recordings and interviews (group and individual interviews). During the first case study, the students also wrote learning diaries. The data collected from the questionnaires were analyzed using statistical methods, whereas the qualitative data were analyzed using a qualitative content analysis method.

The principle result of this study is a pedagogical model, which is informed by educational theories and previously developed pedagogical models, as well as previous studies related to simulation-based education. However, it also provides information concerning the current pedagogical use of simulations. The present study ascertains that teaching is seen as entailing the facilitation of students' learning and is viewed mostly as a student-centered activity. However, there are differing viewpoints that can cause friction during the instructional process. The pedagogical use of SBLEs also sets various requirements for the healthcare educator. Students' expectations of simulation-based learning were also high. Furthermore, simulation-based learning can be viewed as meaningful, although special attention should be paid to goal-oriented, self-directed and individual characteristics of meaningful learning. The research results have several implications for research, theory and practice.

Keywords: facilitators, students, pedagogical model, meaningful learning, facilitating, training and learning process, healthcare education, simulation-based learning environment

TIIVISTELMÄ

Tuulikki Keskitalo
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Tutkimuksen tarkoituksena on ymmärtää simulaatioympäristöissä tapahtuvaa opetusta ja oppimista sekä kehittää pedagoginen malli ohjaajien tueksi. Pedagogisen mallin tarkoituksena on auttaa ohjaajia suunnittelemaan, toteuttamaan ja arvioimaan opetustaan sekä edistämään opiskelijoiden mielekästä oppimista. Tätä tarkoitusta varten asetin useita tutkimuskysymyksiä, joita lähestyin design-perustaisen - ja tapaustutkimuksen keinoin. Niitä hyödyntämällä pystyin vastaamaan erilaisiin tutkimuskysymyksiin ja kehittämään teoriaa sekä käytäntöä. Kaiken kaikkiaan tutkimukseeni osallistui 21 ohjaajaa ja 136 opiskelijaa. Ensimmäisessä osatutkimuksessa haastattelin kahdeksaa terveydenhuollon opettajaa heidän omaksumistaan pedagogisista lähestymistavoista ja käyttämistään opetusvälineistä. Toisessa osatutkimuksessa tutkin terveydenhuollon opiskelijoiden (n = 97) odotuksia simulaatioperustaisesta opetuksesta, opiskelusta ja oppimisesta. Tämän lisäksi keräsimme aineistoa kahden tapaustutkimuksen aikana. Kummankin tapaustutkimuksen aikana opiskelijat harjoittelivat simulaatioympäristössä opiskeltavaan aiheeseen liittyen. Aineistonkeräysmenetelminä olivat alku- ja loppukyselyt, havainnointi- ja kenttämuistiinpanot, videotallenteet sekä haastattelut (ryhmä- ja yksilöhaastattelut). Ensimmäisen tapaustutkimuksen opiskelijat kirjoittivat myös oppimispäiväkirjaa. Kvantitatiivinen aineisto analysoitiin tilastollisin menetelmin ja laadullinen aineisto analysoitiin laadullisella sisällönanalyysimenetelmällä.

Tutkimuksen keskeisenä tuloksena syntyi pedagoginen malli. Malli perustuu sosiokulttuuriseen näkökulmaan ja mielekkääseen oppimiseen, olemassa oleviin pedagogisiin malleihin sekä aikaisempiin alan tutkimuksiin. Sen rinnalla syntyi uutta tietoa simulaatioympäristöjen pedagogisesta käytöstä terveydenhuollon ja lääketieteen opetuksessa. Tutkimus vahvisti, että opetus simulaatioympäristöissä on ohjausta, ja parhaimmillaan opiskelijakeskeistä. Toisaalta tutkimuksessa tuli ilmi, että osallistujien käsitykset opetuksesta ja oppimisesta voivat vaihdella, mikä voi aiheuttaa hankaluuksia opetustilanteessa. Tutkimus vahvisti edelleen simulaatioympäristöjen tuomat vaatimukset ohjaajien asiantuntemukselle. Opiskelijoiden odotukset simulaatioperustaisesta opetuksesta ja oppimisesta olivat myös korkealla. Edelleen voidaan todeta, että simulaatioperustainen opetus on mielekästä, mutta erityistä huomiota vaativat kuitenkin opetuksen ja opiskelun tavoitesuuntautuneisuus, itseohjautuvuus ja yksilöllisyys. Tutkimustuloksilla voidaan katsoa olevan useita tutkimusta, teoriaa ja käytäntöä ohjaavia seuraamuksia.

Avainsanat: ohjaaja, opiskelija, pedagoginen malli, mielekäs oppiminen, ohjaus-, harjoittelu- ja oppimisprosessi, terveysalan koulutus, simulaatioperustainen oppimisympäristö

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Ylikylä, Rovaniemi, February 2015

Tuulikki Keskitalo

LIST *of* ARTICLES

Sub-study I

Keskitalo, T. (2011). Teachers' conceptions and their approaches to teaching in virtual reality and simulation-based learning environments. *Teachers and Teaching: Theory and Practice, 17*(1), 131–147.

Sub-study II

Keskitalo, T. (2012). Students' expectations of the learning process in virtual reality and simulation-based learning environments. *Australasian Journal of Educational Technology, 28*(5), 841–856.

Sub-study III

Keskitalo, T., Ruokamo, H., Väisänen, O. & Gaba, D. (2013). Healthcare facilitators' and students' conceptions of teaching and learning – An international case study. *International Journal of Educational Research, 62,* 175–186.

Sub-study IV

Keskitalo, T., Ruokamo, H. & Gaba, D. (2014). Towards Meaningful Simulation-based Learning with Medical Students and Junior Physicians. *Medical Teacher,* 36(3), 230–239.

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1 INTRODUCTION

The use of simulations for educational purposes is not new (Nehring & Lashley, 2009; Rosen, 2008). Up until now they have been implemented intuitively and, in some cases, simply because we have such an innovative technology that we can use. Intuitive decisions are not indefensible; neither is the use of the learning technology for the right purposes. However, a simulation is definitely a learning environment (cf. Dieckmann, 2009a) and, therefore, should be used carefully and in a way that is supported by appropriate learning theories.

Simulations and virtual realities are currently a point of focus in healthcare education around the world (Helle & Säljö, 2012). They have been seen as providing many advantages for basic education, advanced training, research and assessment (Cook et al., 2011). These advantages include the provision of a safe and realistic environment in which to repeatedly practice and maintain the competence of healthcare professionals, teach rare events, integrate theory into practice, and promote active and experiential learning, to mention just a few. Eventually, this is expected to lead to enhanced patient safety. A number of authors (e.g., Helle & Säljö, 2012; Keskitalo, 2011; Kneebone, 2003; Silvennoinen, 2014) agree that simulation technology is not sufficient by itself to guarantee efficient learning. This suggests that we need appropriate theories, models and methods to help educators plan, organize and evaluate teaching in technology-supported learning environments. Although simulation-based education has been noted to be effective in many ways, it is not currently well known when and how simulation-based education should be applied (Cook et al., 2011; Helle & Säljö, 2012).

The purpose of my research is to facilitate healthcare education in simulation-based learning environments (SBLEs). In particular, the aim of this study is to give examples of how simulation-based education can be applied in pedagogically appropriate ways by developing a pedagogical model. This study contributes to simulation-based healthcare education by taking an educational perspective on this rather unexplored topic. Previous studies have mainly focused on studying the effectiveness of particular simulation technologies for students' learning (Cook et al., 2011), but it is crucial that we also study simulation-based learning from an educational viewpoint in a rich, qualitative manner. As Collins, Joseph and Bielaczyc (2004) have stated, we must apply multiple measures in order to see if a particular innovation really works, since the success or failure of any given innovation cannot be evaluated only in terms of how much students have learned. Silvennoinen (2014) has also argued that multidisciplinary views on the topic are necessary in order to develop the field.

Simulation-based learning has previously been informed by, for example, Kolb's (1984) experiential learning theory, Vygotsky's (1978) ideas on learning, and the principles of adult learning (e.g., Knowles, 1990). Generally, in simulation-based learning we are educating adult learners who are independent, self-directed and intrinsically motivated learners and who are presupposed to have previous life experience. During simulation-based education, concrete experiences are the catalyst for learning which is reflected upon in debriefing sessions. In addition, Vygotsky's idea of *zone of proximal development* has provided insights for facilitators as far as how to support students' learning. However, the field of simulation-based learning has lacked a synthesis of these various perspectives.

The present study contributes to simulation-based healthcare education by designing a pedagogical model which is a synthesis of various educational perspectives. In this study, I combine socio-cultural theory (e.g., Lave & Wenger, 1991; Palincsar, 1998; Säljö, 2009; Vygotsky, 1978) as well as the characteristics of meaningful learning (e.g., Ausubel, 1968; Ausubel, Novak & Hanesian, 1978; Hakkarainen, 2007; Jonassen, 1995) and previous pedagogical models (e.g., Joyce, Calhoun & Hopkins, 2002; Dieckmann, 2009b) with simulation-based learning research in order to construct a theory and a pedagogical model. Socio-cultural theory forms the underlying theoretical framework of this research, which is based on the assumption that learning and knowledge are not located within the individual; rather learning results from constant interplay between the individual, social environment and tools. The characteristics of meaningful learning help to bring to the forefront issues that are topical in many current learning theories and have been proven to enhance learning (e.g., Merrill, 2002). Furthermore, previous pedagogical models and studies undertaken as part of this research have helped to structure the simulation-based learning process.

The concept of the pedagogical model is understood in the present study in the sense given by Joyce and Weil (1980, p. 1), according to whom a pedagogical model can be viewed as "a plan or pattern that can be used to shape curriculums (long-term courses of studies), to design instructional materials, and to guide instruction in the classroom and other settings". Pedagogical models are especially valuable for educators who use educational technology in their teaching (Alinier, 2011; Randolph, Kangas, Ruokamo & Hyvönen, 2013; Keskitalo, 2011) since they help to support the facilitator's own thinking, make the students' point of view more visible, as well as helping the facilitator realize the learning event in a well-planned manner. In this dissertation, I will use the term *facilitator* rather than *teacher*, which differs from the term used in some of the original articles. I have also adopted consistent terminology across the study which differs to some extent from the terms used in the original publications. However, I believe such changes will make the text more consistent and easier to read.

The context of this study is SBLEs. By labeling them this way, I seek to emphasize the learning purpose of these technologically rich, but safe and experiential learning environments. The starting point for the present study was the construction of the ENVI Virtual Center for Wellness Campus™, which created pedagogical development needs among the facilitators, since it was a novel environment in which no facilitators had ever taught before. As ENVI combined virtual reality (*VR*) and simulation technology, it was quite different from other simulation centers (for a more detailed description of ENVI, see chapter 6). Since 2007 I have been involved in the development of pedagogy for ENVI and other SBLEs through various multidisciplinary research projects[1] and diverse partners.

My focus during this research has been to understand the basis on which facilitators establish their teaching and the educational tools and pedagogical models and methods they use (Sub-study I). I also investigate students' expectation of simulation-based learning (Sub-study II). Sub-study III investigates healthcare facilitators' and students' conceptions of teaching and learning in SBLEs, whereas Sub-study IV concentrates on understanding meaningful learning and designing a pedagogical model. Many of these topics had not previously been investigated within the context of SBLEs.

The present study provides valuable insight into the current discussion on simulation-based healthcare education. By combining different learning theory perspectives and methodologies, I have been able to deepen our understanding of simulation-based learning and develop a pedagogical model that combines these multiple learning theory viewpoints in a way that, to my knowledge, has not been done before. This pedagogical model will help facilitators comprehensively plan, organize and evaluate their instruction so that students can benefit from learning that is even more meaningful than what currently exists. For researchers in many fields, this study can provide new insights into simulation-based healthcare education research. Technological designers can also benefit from the model, since the pedagogical basis for SBLEs is explained.

1. The MediPeda projects (2007–2010) aimed at developing a pedagogical model for VR and SBLEs, as well as developing user-centered design methods and evaluating a co-creation model (www.ulapland.fi/medipeda). MediPro (2012–2014) was established to continue the development of simulation pedagogy, as well as to gather information for the development of the official TETRA telephones and the TETRAsim simulation program (www.ulapland.fi/medipro). MediPeda III was funded by Tekes (The Finnish Funding Agency for Technology and Innovations) and the EDRF (The European Regional Development Fund), as well as a number of public and private financiers. The MediPro project was funded by Tekes' Learning Solutions Program, the hospital district of Lapland, and the city of Rovaniemi. Both projects were part of the Cicero Learning Network.

2 AIMS *of the* STUDY

The aim of the present study is to explore simulation-based learning and to design a pedagogical model for innovative learning environments like SBLEs in health-care education. In particular, this study aims to:

1) find out on what facilitators base their teaching and what educational tools, pedagogical models and methods they use in their teaching in SBLEs (Sub-study I),
2) explore students' expectations of simulation-based learning (Sub-study II),
3) increase our knowledge of conceptions of teaching and learning in SBLEs (Sub-study III), and
4) design a pedagogical model that supports students' meaningful learning and assists facilitators in their teaching practices (Sub-study IV).

This dissertation will first present the theoretical background of the research. Thereafter, I will present the research questions and methodological choices. Towards the end of the study I will summarize and evaluate the original publications which form the basis for the construction of the theory and the pedagogical model. Finally, I will discuss the outcomes of the research and their limitations and practical implications in general, as well as providing some suggestions for future research.

3 THEORETICAL BACKGROUND *for* SIMULATION-BASED LEARNING *in* HEALTHCARE

In this chapter I will introduce the theoretical background of the present dissertation, which forms the basis of the pedagogical model presented here. The pedagogical model is a synthesis of three different theoretical frameworks: the socio-cultural theory of learning, meaningful learning, and previous pedagogical models. The studies undertaken as part of this research journey (Sub-studies I-IV) have also influenced the development of the model. In the following sections, the theoretical viewpoints underpinning the research and the pedagogical model will be presented in more detail.

3.1 Socio-cultural Basis of the Study

The present research is informed by the socio-cultural theory of learning (Lave & Wenger, 1991; Palincsar, 1998; Vygotsky, 1978). This theory posits that learning is tool-dependent as well as being influenced by social, cultural and historical factors (Säljö, 2004; 2009; Vygotsky, 1978) which themselves are also constantly changing (Palincsar, 1998). As applied here, this means that individual learning is not separated from social influences; instead, learning is considered to be a social process involving constant interplay between the individual, the social and the contextual factors (Hickey, 1997; Säljö, 2004). According to these views, knowledge is the result of a shared and contextually-bound process of knowledge construction rather than solely an individual experience. Thus, the socio-cultural approach to learning is naturally related to socio-constructivist views of learning (Palincsar, 1998). Socio-cultural theory also emphasizes mediated action: that is, human action is mediated by cognitive tools such as symbols, language, tools and artefacts (Palincsar, 1998; Säljö, 2004; 2010; Vygotsky, 1978), thus fundamentally changing the process of learning and knowledge construction (Laurillard, 2012). According to Palincsar (1998), cognitive tools facilitate the construction of knowledge and skills, but they are also internalized in order to aid learning in the future.

The central theme in Vygotsky's (1978) theory is the idea of *zone of proximal development*, which has been a useful instructional principle in medical and healthcare education as well (Kneebone, Scott, Darzi & Horrocks, 2004). Vygotsky distinguished between the actual and potential levels of development. The potential level of development is attainable only through cooperation with a more capable peer, whereas the actual level of development can be reached by the learner on his or her own. By applying Vygotsky's distinction to simulation-based learning in healthcare education, new skills and knowledge are learned during the collaborative problem-solving task with the help of peers and facilitators. The role of the facilitators is to provide appropriate and gradually fading support as well as feedback that reinforces the learning.

In the pedagogical model presented in this dissertation, I have placed the socio-cultural context around the SBLE in order to emphasize that individual and social factors are always associated with learning and, therefore, learning must be considered in the situation in which it take place (Palincsar, 1998; Säljö, 2009). As Greeno (1997, p. 8) has asserted, "Just presenting hypotheses about the knowledge someone has acquired, considered as structures in the person's mind, is unacceptably incomplete, because it does not specify how the other systems in the environment contribute to the interaction". In the present study the socio-cultural viewpoints help us consider learning in a wider perspective, because learning within SBLEs can be seen very much as a social process where learners interact with each other and with various kinds of equipment (Dieckmann, Gaba & Rall, 2007; Rystedt & Sjöblom, 2012; Säljö, 2004; 2009). These environments are also situated in a particular context in which the learning takes place. These viewpoints also help to bring to the forefront the participants' prior knowledge and life experiences, both of which affect how the participants interact within the environment and how they come to learn and what they learn (Säljö, 2010). As noted by Palincsar (1998), from a Vygotskian perspective we can start to understand the complexity of learning and development and the process through which tools, practices and institutions are transformed.

The socio-cultural approach has also influenced my methodological choices and the unit of analysis in the course of this study (Smith, 1999; Säljö, 2009). As a researcher I have observed the activity in real situations and in discussions with participants in order to find out what constitutes learning in this particular learning environment (Säljö, 2009) and how this kind of learning can be facilitated. Packer and Goicoechea (2000, p. 232) have also noted that "what counts as real varies culturally and changes historically"; therefore, the data produced by the present research can be viewed as being bound to certain social, cultural and historical situations.

However, I also argue that learning cannot be considered from only one theoretical viewpoint, since there is no "grant theory" of learning (Alexander, Schallert & Reynolds, 2009, p. 189; see also Cobb & Yackel, 1999; Säljö, 2009). Therefore, I take different perspectives on learning into account when studying simulation-based learning, which I think gives a more complete and richer view of the phenomenon.

As Laurillard (2012, p. 63) has stated, we must "treat the contrasting theories as complimentary rather than oppositional". In the following section, I will introduce the characteristics of meaningful learning, which, in my opinion, are a combination of various theoretical viewpoints and can be used to guide simulation-based learning.

3.2 Characteristics of Meaningful Learning in SBLEs

The concept of meaningful learning was first presented by Ausubel (1968) and later developed by many authors in various contexts (e.g., Ausubel et al., 1978; Hakkarainen, 2007; Jonassen, 1995; Keskitalo, Pyykkö & Ruokamo, 2011; Löfström & Nevgi, 2007; Ruokamo & Pohjolainen, 2000). For Ausubel, Novak and Hanesian (1978), meaningful learning is a process whereby new information is assimilated to what the learner already knows; thus, this approach resembles the constructivist view of learning. In addition, according to this view, both the learning materials and task must be meaningful, and the learners must engage themselves in the meaningful learning process (Ausubel et al., 1978). Later Jonassen (1995) developed Ausubel's ideas in a more social constructivist direction. According to Jonassen (1995), learning in schools and universities should emphasize active, constructive, collaborative, intentional, conversational, contextualized and reflective qualities of meaningful learning. In this study, we have developed those characteristics in a more practice-oriented direction.

The characteristics of meaningful learning used in the present study were chosen because they can be used as a practical aid for healthcare educators in planning, organizing and evaluating learning processes in an SBLE. With these theoretical viewpoints in mind, the facilitator can plan, implement and evaluate the entire instructional process in order to enhance the quality of the students' learning experience. These characteristics can also help us concretize more general learning theories (Karagiorgi & Symeou, 2005) – in this case the socio-cultural theory of learning (Jonassen, 1995; Palincsar, 1998) – as well as bringing issues that are known to enhance learning to the fore (Dolmans, De Grave, Wolfhagen & van der Vleuten, 2005; Merrill, 2002). Through the characteristics of meaningful learning we can emphasize the importance of, for instance, *activity, experiences, reflection, knowledge construction, collaboration* and *situativeness* among the things that are important for current learning theories (Dolmans et al., 2005; Laurillard, 2012).

In this study, the fourteen characteristics of meaningful learning are used to describe, foster and evaluate students' meaningful learning in SBLEs. The special characteristics of students, the learning environment, and the course content are also considered when developing the model based on the characteristics of meaningful learning. In the following table (Table 1, adapted from Keskitalo, Ruokamo

& Gaba, 2014), I will present *what* these special characteristics are, *how* they can be understood and implemented in these particular learning environments, and *why* it is important to take them into account. Jonassen (1995) has stated that these characteristics are overlapping and interconnected, and therefore I have chosen to present these characteristics in pairs that are generally overlapping.

Table 1. Characteristics of meaningful learning and their practical implications.

Characteristics	
1. Experiential and 2. Experimental	**What?** Using prior experiences as a starting point for learning (Gibbs, 1988; Kolb, 1984; Zigmont, Kappus & Sudikoff, 2011a), but also having a valuable opportunity to experiment with new tools, devices, situations, roles, theories, etc. before entering the healthcare practice (Gaba, 2004; Cleave-Hogg & Morgan, 2002). **Why?** Former experiences guide our behavior and learning (Carlson, Miller, Heth, Donahoe & Martin, 2010; Dieckmann, 2009b); therefore they should be taken into consideration. Concretely doing and experimenting, as well as making sense of these concrete experiences, is the essential aim of simulation-based learning (e.g., Alinier, 2011; Fanning & Gaba, 2007; Keskitalo, 2011; 2012). **How?** The *environment* and *tasks* make it possible for students to engage in active examination and experimentation. The *facilitator* takes into account the students' prior experiences and actively encourages them to use these experiences in learning and in responding to opportunities to acquire new ones (Zigmont et al., 2011a). *Students* utilize, reflect on, and accommodate prior experiences and engage in acquiring new ones.
3. Emotional	**What?** Simulation-based learning is designed to generate emotional experiences. Emotional responses should be taken into account during the debriefing phase (Keskitalo, Ruokamo & Väisänen, 2010; Zigmont, Kappus & Sudikoff, 2011b). **Why?** Emotions are always intertwined with learning (Engeström, 1982; Immordino-Yang & Faeth, 2010; Schuzt & DeCuir, 2002), especially in simulation-based learning. Emotions affect motivation, but they also have an impact on how students act in the learning environment and what they remember later on (Damasio, 2001; DeMaria et al., 2010; Trigwell, 2012). Therefore, we should take them into account. **How?** *The environment*, *scenarios* and *materials* are constructed to generate emotions (DeMaria et al., 2010). The *facilitator* prepares the students for the forthcoming learning event during the introduction and simulator and scenario briefing phases, as well as taking emotional responses into account, e.g., during the debriefing (Dieckmann & Yliniemi, 2012). *Students* are willing to engage and reflect on their feelings and consider the influence of their feelings on their motivation, activity, work, etc. (Dieckmann et al., 2007; Keskitalo et al., 2010).

4. Socio-constructive and 5. Collaborative	**What?** Students evaluate and accommodate new ideas on the basis of their previous knowledge during the joint learning process (Dolmans et al., 2005; Jonassen, 1995; Keskitalo, 2012; Löfström & Nevgi, 2007; Dieckmann et al., 2007). **Why?** In most cases, simulation-based learning is designed to be a collaborative undertaking. The aim is for students to participate in the enquiry process and gradually accumulate knowledge about the patient's condition from their previous knowledge, their peers, the patient's file and the medical investigations, as well as other sources, in order to deliver the correct treatment (Alinier, 2011). **How?** The *environment*, *tasks* and *materials* support students' knowledge construction and collaboration. The environment can include tools with which knowledge can be retrieved and stored for later use. The *facilitator* develops tasks that are based on the students' prior knowledge, conceptions and beliefs and that require collaborative activity (e.g., Fanning & Gaba, 2007). He/she also directs the collaborative activities and knowledge construction. The *students* participate in the interaction, bringing their knowledge, understanding and skills to the joint activity and discussion. They apply and practice knowledge and skills using different senses, learning strategies, roles, etc. (Merriënboer & Sweller, 2010; Tynjälä, 1999).
6. Active and 7. Responsible	**What?** The students' role is active, and the students are responsible for their own learning. The facilitator guides rather than lectures (Fanning & Gaba, 2007; Issenberg, McGaghie, Petrusa, Gordon & Scalese, 2005; Jonassen, 1995; 2002; Keskitalo, 2011). **Why?** SBLEs are designed to be replicates of real working life (Alinier, 2011; Issenberg et al., 2005), where treating the patient is the most essential thing to do. The purpose of SBLEs is for students to learn to manage the necessary skills and knowledge in order to work as skillful healthcare professionals. Therefore, we should encourage students to work as they would do in real life. **How?** The *environment* supports student activity. In addition, the *assignments* and the *learning materials* support students' active information retrieval, evaluation and construction. The *facilitator* plans meaningful learning activities and encourages the students to apply their knowledge and practice skills during the learning process (Alinier, 2011). The *students* are active and responsible in the practicing, retrieval, evaluation and application of knowledge as well as in discussion and reflection (Issenberg et al., 2005).

8. Reflective and 9. Critical	**What?** Critical reflection on one's own learning, learning strategies, knowledge, skills, attitudes, and the learning environment (Fanning & Gaba, 2007; Hakkarainen, 2007; Issenberg et al., 2005; Jonassen, 1995; Rudolph, Simon, Rivard, Dufresne & Raemer, 2007). **Why?** Critical reflection on the learning process is often considered to be the most critical phase of simulation-based learning as it enhances the students' learning (Alinier, 2011; Cook et al., 2011; Dreifuerst, 2012; Issenberg et al., 2005). **How?** The *environment* includes things that support the students' reflection (e.g., a video camera, TV, peaceful and pleasant room, safe atmosphere, competent instructor, etc.). In addition *assignments* (e.g., a learning diary) can support the students' reflection. The *facilitator* supports the students' reflection by asking questions, specifying, elaborating, guiding, etc. (e.g., Rudolph et al., 2007). The *students* reflect on their own learning processes and the decision making that was involved in these processes (Dreifuerst, 2012; Rudolph et al., 2007). Students receive and give feedback (Jonassen, 1995).
10. Competence-based and 11. Contextual	**What?** Learning is contextual; thus learning objectives are simulated through real-life cases and examples that have their origin in working life (Alinier, 2011; Dolmans et al., 2005; Hakkarainen, 2007; Jonassen 1995; Keskitalo, 2011; 2012; Löfström & Nevgi, 2007; Ruokamo & Pohjolainen, 2000). **Why?** Information is best learned when it is taught and practiced in a context that resembles real life (Bransford, Brown & Cocking, 1999). The aim of simulation-based learning is to educate skillful and adult professionals who have the ability to demonstrate the actions and skills needed in real working life (Anema, 2010). **How?** The *environment* includes authentic tools and devices which are embedded in real-life cases (Alinier, 2011). Content is simulated through real-life cases and presented in a variety of ways and from different perspectives (Dolmans et al., 2005). In addition, the *learning objectives* are based on the competence that is required in real working life (Harden, Crosby, Davis & Friedman, 1999). The *facilitator* plans appropriate and sufficiently authentic scenarios for the students' learning and formulates the learning objectives together with the students, if possible. This engages them better in learning and makes them conscious of the competence they will need to have in the future (Schuzt & DeCuir, 2002; Gibbons, Bailey, Comeau, Schmuck, Seymour & Wallace, 1980). The *students* try to find out solutions and different perspectives on the issues and compare the learning situation to the real world (Schuzt & DeCuir, 2002; Tynjälä, 1999).

12. Goal-oriented and 13. Self-directed	**What?** Setting general learning objectives as well as one's own learning goals and following up on those goals during the learning process (Brockett & Hiemstra, 1991; Dolmans et al., 2005; Jonassen, 1995; Keskitalo, 2012; Keskitalo et al., 2010; 2014; O'Shea, 2003; Schuzt & DeCuir, 2002). **Why?** Goals direct our thoughts, behavior and strategies, and without clear goals it is difficult to find ways to solve problems (Dieckmann, 2009b; Schuzt & DeCuir, 2002). Simulation-based learning is also about educating adult learners who are self-directed and intrinsically motivated by nature (Fanning & Gaba, 2007). **How?** The *environment*, *assignments* and *materials* support the planning, follow-up and evaluation of students' own learning. In SBLEs, video recordings, discussions, learning diaries, observational ratings, tests, etc. can be used to evaluate learning. The *facilitator* supports, guides and maintains the students' learning processes. The facilitator models, encourages and gives timely support. The *student*s set their own learning goals and actively try to fulfill them.
14. Individual	**What?** Taking into account individual differences; providing individual guidance and feedback (Hakkarainen, 2007; Keskitalo et al., 2010; 2014; McGaghie, Issenberg, Petrusa & Scalese, 2010; Ruokamo & Pohjolainen, 2000). **Why?** Learning is different for each individual (De Corte, 1995), and students also perceive the learning environment differently. Therefore, individual differences should be considered whenever possible (Alinier, 2011; Zigmont et al., 2011a). **How?** The *environment*, *assignments* and *materials* support different learning styles. The environment can be changed to meet various needs. The *facilitator* familiarizes him/herself with the students and gives individual feedback and support. The *students* can train using the strategies that are best suited for them and receive individual feedback from and about their own learning.

The characteristics of meaningful learning can be used to create a good basis for learning. Since they take the approaches of various learning theories into account, they can help to create learning experiences that are more holistic and meaningful. Jonassen (1995) has also stated that learning can also be meaningful even if not all of the characteristics of meaningful learning are present all the time. However, the right combination of these characteristics generally results in more meaningful learning than would result from the presence of only one of the characteristics by itself.

3.3 Previously Developed Pedagogical Models for Simulation-based Learning in Healthcare

Kolb's (1984) experiential learning theory is the most widely-used educational theory that has been applied to understand and orchestrate the teaching and learning processes in simulation-based learning environments (Anderson, Aylor & Leonard, 2008; Craft, Feldon & Brown, 2014; Poore, Cullen & Schaar, 2014; Zigmont et al., 2011a; Wang, 2011). In experiential learning, experiences – either simulated or real – provide the catalyst for learning. Learning is attained when the learner reflects on and transforms the experiences into knowledge that is usable in future practice (Kolb, 1984). From Kolb's (1984) perspective, learning is holistic and a life-long process, where "all learning is relearning."

Kolb (1984) created a learning cycle that involves four phases: 1) *concrete experience* is the phase in which the learner participates in an experience, such as simulation; 2) then the learner reflects on that experience (*reflective observation*); 3) after experiencing and reflecting, the individual is able to think logically about the situation, and accommodate or shape his or her mental model into a more coherent theory (*abstract conceptualization*); and 4) finally, the learner is ready to test this theory in a new simulation or in real life (*active experimentation*). In the field of simulation-based healthcare and medical education, it is commonly thought that concrete experience is the phase in which the learners participate in the simulation; thereafter, they reflect on and conceptualize the experience during the debriefing phase; and in an ideal situation, they can test their newly formed theories in real life or in a new simulation scenario (Zigmont et al., 2011b).

In recent years, researchers have developed more specific models of how to orchestrate simulation-based learning, either in general applications or specifically in the field of healthcare education. Both the *Learning through simulation* model (Joyce et al., 2002) and the *Simulation setting* model (Dieckmann, 2009b) have influenced the development of the model presented in this dissertation. Dieckmann's (2009b) model is specifically intended for simulation-based healthcare education, whereas Joyce et al. (2002) created a general model for simulation-based education. However, these two models have a great deal in common, and therefore I have taken both of them into consideration when developing the pedagogical model for simulation-based learning in healthcare. Both models include the following four phases: (1) introduction, (2) simulator briefing, (3) scenarios, and (4) debriefing (Dieckmann, 2009b; Joyce et al., 2002). I see these as the main phases, and I have embedded them in the pedagogical model. As noted earlier, these phases are also congruent with Kolb's (1984) experiential learning cycle. Dieckmann's (2009) model includes three additional phases, namely *Theory, Scenario briefing,* and *Course ending*. The *Scenario briefing* and *Course ending* phases are usually present in simulation-based courses, although I do not refer to them as such in the pedagogical model. However, Dieckmann and others (2012) have also stated that their model is flexible in nature since the number and order of the phases can vary.

Most researchers agree that simulation-based education starts with *the introduction*. It is often stated that the most important goal for this phase is the creation of a safe and non-threatening atmosphere (Boese et al., 2013; Clapper, 2010; Dieckmann, 2009b; Dieckmann et al., 2012; Wang, 2011; Zigmont et al., 2011a), as participating in a simulation can be stressful (Brewer, 2011; Weller, 2004). A successful introductory phase sets ground rules, creates an initial and joint knowledge base and a positive atmosphere, as well as creating the script and schedule for the upcoming learning event (Dieckmann et al., 2012).

During *the simulator and scenario briefing* phases, participants get to know the physical environment and the case that will be handled. It is good for the participants to be aware of what is considered normal in the simulator compared to what is normal in a real patient. Therefore, hands-on time is important in this phase (Dieckmann, 2009b). *Scenarios* are the phase in which the students take the leading role when practicing with and in the SBLE. From the viewpoint of learning theory, in this phase learners have a chance to use the knowledge and skills of a discipline in order to understand things more deeply (Laurillard, 2012). During this phase, the facilitator's role is to remain on the sidelines and monitor the participants' behavior.

Debriefing is the final phase of simulation-based education, and it is often stated that it is the most important phase of simulation-based education (Wang, 2011), since this is the phase when students can review and reflect on their learning and identify potential knowledge gaps. Studies have proposed different models for conducting the debriefing phase (Dreifuerst, 2012; Dufrene & Young, 2014; Fanning & Gaba, 2007; Rudolph et al., 2007; Steinwachs, 1992; Zigmont et al., 2011b), although there is currently no clear evidence that one particular method is better than any other (Dufrene & Young, 2014). However, there is undisputable evidence that feedback is essential for enhancing the learning (Issenberg et al., 2005; Norman & Schmidt, 1992) and the expertise (Ericsson, Krampe & Tesch-Römer, 1993).The basic goal of the debriefing is for the participants to review their understanding and skills as well as formulate new learning objectives (Rudolph et al., 2007). According to Rudolph et al. (2007, p. 361), the goals and processes of the debriefing are:

> …to allow trainees to explain, analyze, and synthesize information and emotional states to improve performance in similar situations in the future. The process for achieving these goals usually follows a series of steps, such

as processing reactions, analyzing the situation, generalizing to everyday experience, and shaping future actions by lessons learned.

Steinwachs (1992) has proposed a three-phase model of debriefing, which is quite typical in simulation-based education (see also Konia & Yao, 2013). The first phase is *the description phase*, where the learners basically describe what has happened and share their first impressions and feelings about the scenario. As Dieckmann (2009b) points out, a typical question in this phase is "What happened?" In the next phase, *the analysis phase*, the participants go deeper into the scenario and figure out the causes and reasons for their decisions and actions. The goal of this phase is to help participants figure out why they acted as they did, and how they can change their mental models in order to behave differently next time, if needed. *The application phase* is when the learners consider what they can take home from the learning experience and what things can be transferred into clinical practice.

To summarize the main points of this chapter, simulation-based learning is usually grounded in the ideas of andragogy, experiential learning and socio-cultural theory. Researchers and practitioners also agree that there are at least four phases that are essential in simulation-based learning. However, as I mentioned earlier, we should consider learning from multiple and multidisciplinary perspectives, which, I think, gives a more complete view of the phenomenon. In this approach, the lens of socio-cultural theory and meaningful learning is useful.

4 SIMULATION-BASED LEARNING ENVIRONMENTS *of* HEALTHCARE

In this fourth chapter I will present SBLEs that are currently used in healthcare and give examples of their current educational uses.

4.1 Defining SBLEs

The term *simulation* serves as an umbrella term for a wide variety of definitions and views of simulation. Currently, there is no single, concise definition of *simulation* or *simulator* (Alinier, 2007). Basically, *simulation* means "an imitation of reality". According to Rall and Dieckmann (2005, p. 274), "simulation, in short, means to do something in the 'as if', to resemble 'reality' (always not perfectly, because then it would be reality again), e.g., to train or learn something without the risks or costs of doing it in reality." These authors also specify that *simulation* has at least two meanings within the medical domain: *simulation mechanism* and *simulation scenario*. A simulation mechanism tries to imitate some aspect of physiology or anatomy, while a simulation scenario refers to an event that is designed around a specific medical problem (Dieckmann & Rall, 2007; 2008).

For Sokolowski (2011) a model is a static representation of reality, whereas a simulation has a temporal feature. Sokolowski (2011) has also divided simulations into live, virtual and constructive forms. In *live simulations* real people use real equipment, but outside the context of a real event. *Virtual simulation* consists of real people employing simulated equipment, whereas *constructive simulation* involves simulated people working with the simulated system. The author also specifies that these three simulation forms can be combined to produce a certain type of simulation environment.

Gaba (2004) classifies medical simulations in five categories based on the technology applicable or required: verbal role playing, standardized patient, part-task trainers, computer-based simulators, and patient simulators (i.e., simulator mannequins). So the simulation techniques range from simple acting to life-size and technologically complex patient simulators. In the healthcare field, *simulator* usually refers to a physically represented interface (Dieckmann, 2009b) that mimics the patient or various parts of the patient (Rall & Dieckmann, 2005). Through the simulator participants can interact with the simulation mechanism. In the field of healthcare, the most commonly used simulators are *patient simulators*. Patient simulators represent a life-size human body, and nowadays they have many features that allow them to react to treatment the same way an actual patient would do. The facilitator or simulator operator usually controls the patient simulator via a computer. An important part of the patient simulator is the monitor, which shows the vital signs of the patient simulator. In the field of simulation-based healthcare education, the term *fidelity* is used to refer to the accuracy with which the simulated environment imitates reality (Littlewood, 2011). Although a high level of fidelity in simulation has often been given priority in education, it is not self-evident that a high level of fidelity enhances learning (Dieckmann et al., 2007; Norman, Dore & Grierson, 2012). According to Alinier (2007), the higher the fidelity of the simulations, the more advanced and skillful the learners must be, since they have to demonstrate not only theoretical knowledge (*knows* and *knows how*), but also practical knowledge (*shows how* and *does*).

In addition to the patient simulator, there are many other technologies that can be used during simulation-based training: e.g., *part-task trainers* and *virtual reality (VR) simulators* (Alinier, 2007; Lane, Slavin & Ziv, 2001; Nehring & Lashley, 2009). Part-task trainers replicate certain parts of the human body and allow learners to train for a particular task or develop certain skills (e.g., management of airways). In the research literature, VR is also defined in various ways; however, I understand VR as a combination of techniques that are used to create and maintain real or imaginary environments (Cobb & Fraser, 2005; Gaba, 2004; Riva, 2003). Therefore, the VR simulator is comparable to *constructive simulation*, the term used by Sokolowski (2011).

In this dissertation, I have used the term *simulation-based learning environment*, which is comparatively rare in the research literature. Within the healthcare domain, the terms *simulation*, *simulation centers* and *simulators* are in common use. In talking about SBLEs, I want to emphasize the learning purpose of these environments (cf. Dieckmann, 2009a). These environments can also be used for research and the assessment of medical devices, but in my research the main goal is to elicit discussion concerning the pedagogical use of SBLEs and to develop their pedagogically meaningful use. From a learning theory point of view, the SBLE is a complex cultural, social, physical and pedagogical environment that enables the participants to engage in experiential learning in a safe setting (Dieckmann et al., 2012). Because SBLEs always exist in a given context where the activities are ultimately formed by the participants, they can be considered as cultural and social environments. SBLEs are also shaped by the technology and physical surroundings, as well as by the pedagogical viewpoints of their users. SBLEs should be harnessed for active and meaningful learning; therefore, it is essential that training in these environments has a suitable pedagogical grounding.

In this study I have focused on courses where the learners actively treat patient simulators during the simulation scenario. The scenario is usually designed around the course topic and discussed afterwards in the debriefing phase. However, it should be borne in mind that there are also other types of simulation-based training. For example, *skills stations* are designed to help students learn individual skills (e.g., measuring blood pressure) or protocols (e.g., resuscitation) individually, in pairs or in groups.

4.2 Educational Use of SBLEs

Simulation has long been used for educational purposes, if we consider the simplest and broadest definition of *simulation*, which is "an imitation of reality" (Nehring & Lashley, 2009; Rosen, 2008). Our predecessors built simple models of human anatomy and diseases or recreated the symptoms of certain illnesses. Role playing has also been used for a long time to teach learners empathy and skills in human interaction (Lane et al., 2001; Nehring & Lashley, 2009). One popular method has been (and still is) the apprenticeship model, where an expert – here an experienced doctor or nurse – shows the more in-experienced one how a certain procedure or treatment should be done, and then the apprentice tries to imitate the desired behavior with the master's guidance and help (Rogoff, 1990).

Advancements in technology and plastics, a growing body of research, and proof of their usefulness in learning and patient safety issues have led to an increase in the use of more complex simulators and SBLEs (Bradley, 2006; Cook et al., 2011; Gaba, 2004; McGaghie et al., 2010; Rosen, 2008). However, this increase has occurred only recently. The military and aviation industry were the first to train their staff through simulations, whereas the medical field gradually expanded its use of modern simulation techniques only towards the end of the 20th century (Rosen, 2008).

Gaba (2004, p. 2) comes close to educational thinking when he sees simulation more as a technique, rather than a technology. To analyze the diversity of applications of simulations in the healthcare field, Gaba lists 11 dimensions, namely: (1) the aims and purposes of the simulation activity, (2) the unit of participation, (3) the experience level of the participants, (4) the healthcare domain, (5) the professional discipline of the participants, (6) the type of knowledge, skills, attitudes or behaviors addressed, (7) the simulated patient's age, (8) the applicable or required technology, (9) the site of the simulation, (10) the extent of direct participation, and (11) the method of feedback used. I consider this comprehensive framework to be useful in trying to understand such a multifaceted phenomenon as simulation-based education.

With respect to Gaba's first (1) dimension, the aim or purpose of the activity, simulations in the field of healthcare are used mainly for education, training and assessment purposes (cf. Dieckmann & Rall, 2007). During the simulation activity, we can educate and train participants to perform the central tasks and maintain the essential skills needed in the field of healthcare. In the present study, the purpose of the simulations was to educate and train healthcare students, as well as junior doctors, in handling critical healthcare situations (Sub-studies III and IV). However, simulations have also been used more and more to assess the performance of individuals and teams, as well as evaluating the usability of particular clinical equipment (e.g., House et al., 2012; Littlewood, 2011; Morris, Gallagher & Ridgway, 2012; Pibouleau & Chevret, 2013). Gaba's second (2) dimension concerns the unit of participation, which is often a team or an individual (e.g., Siassakos et al., 2013). In the present study, the students were, on all occasions, training in a group format. The experience level of the simulation participants, the third dimension (3), can vary from first-year students to experienced doctors, since the main aim of the simulation is to provide training for practitioners who actually work in the field (Daniel, Lipman, Harney, Arafeh & Druzin, 2008; Dayal, Fisher, Magrane, Goffman, Bernstein & Katz, 2009; Dieckmann & Rall, 2007).

As for Gaba's fourth dimension (4), the domain, simulation-based education is used in almost all fields of healthcare, including fields that need technically skilled professionals (e.g., pediatrics, surgery, obstetrics and cardiology) (Broussard, Myers & Lemoine, 2009; Daniel et al., 2008; Kneebone, 2003) or fields that need skilled teams in order to avoid careless mistakes (e.g., anesthesia, emergency medicine and intensive care) (Howard, Gaba, Fish, Yang & Sarnquist, 1992; Thomas, Williams, Reichman, Lasky, Crandell & Taggart, 2010). Regarding the fifth dimension (5), the professional discipline, SBLEs can be used to train physicians, nurses, paramedics, technicians and many others (Bland, Topping & Wood, 2011; Musacchio et al., 2010; Shrader, Kern, Zoller & Blue, 2013). Gaba's sixth (6) dimension encompasses the type of knowledge, skills, attitudes and behaviors addressed in simulations. In SBLEs learners can acquire new knowledge and practice new skills, as well as combine theory with practice so as to be able to transfer the learned skills to actual healthcare practice. Simulations can also help learners to maintain and refresh skills and knowledge that are not used very often.

With reference to the age of the patient being simulated and the applicable and required technology (Gaba's seventh (7) and eighth (8) dimensions), SBLEs nowadays include many types of patient simulators from baby simulators to adults, as well as many other types of technology. However, sometimes no technology is necessary to achieve the goals of the simulation-based training. In place of technology, we can use role playing, standardized patients, discussion and analysis of digital videos, practice skills with fruits or dolls, or build simple models out of cardboard. In the present study (Sub-studies III and IV), healthcare students and junior physicians were training with a high-fidelity adult patient simulator accompanied by a screen showing the vital signs of the simulator. The room was also decorated in a realistic way (for example, to look like a hospital room) for the students' rehearsal. In addition, one room was dedicated to debriefing sessions where video and audio recording devices were used to complement the students' reflection.

The site of the simulation, Gaba's ninth (9) dimension, is usually a dedicated simulation center, like the simulation centers used in this study. However, mobile *in situ simulations* are becoming more and more common since they can be done in the middle of daily routines, thus saving time and money (see Dieckmann & Rall, 2007). However, the downsides of such mobile simulations are that actual clinical practice sometimes interrupts the exercise and appropriate space for the rehearsal must be found. Whether simulation centers should be located in hospitals, near them, or within educational organizations is still a matter of debate (Kneebone et al., 2004).

The extent of direct participation (10) and the feedback method accompanying simulation (11) are the final two dimensions of Gaba's framework. According to Gaba (2004, p. 6), "not all learning requires direct participation". In simulation-based learning, participants can learn through and within the simulation, but also by observing and analyzing the activity of their peers or the facilitator (Carlson et al., 2010). This was the situation in Sub-studies III–IV. Since only a limited number of students (usually 2–6) can take part in an exercise at the same time, there is usually a group of students who have to follow the exercise from the outside. However, they can participate in the debriefing and give valuable insights to the students who were performing. In simulation-based training, the debriefing phase and reflection are used to maximize learning (see also Issenberg et al., 2005). During the debriefing phase, video and audio recording devices can be used to complement the feedback and enable the participants to participate in thoughtful analysis of the training and see the consequences of their actions.

4.3 Benefits of and Barriers to the Educational Uses of SBLEs

Simulation-based training has proven to have many advantages (Broussard et al., 2009). It has proven to be effective in measuring participants' knowledge, skills and behavior (Norman et al., 2012). It has also been noted to have moderate effects on patient-related outcomes (Cook et al., 2011). Students also seem to enjoy this type of training as it provides an opportunity to practice skills and knowledge needed in the field of healthcare in an experiential and safe way (Cleave-Hogg & Morgan, 2002; Heard, Fredette, Atmadja, Weinstock & Lightdale, 2011). It has also been noted that this type of training enhances students' confidence (Figueroa, Sepanski, Goldberg & Shah, 2013; Morgan & Cleave-Hogg, 2002; Paskins & Peile, 2010). All of these benefits are eventually expected to improve patient safety (Manser, 2009).

These advantages of simulation-based learning are usually emphasized rather than the disadvantages (Solnick & Weiss, 2007). It is an expensive and time-consuming educational process involving modern technology, space and personnel resources (Zigmont et al., 2011a). Before the exercise can even begin, a great deal of time and effort is required of the facilitator to prepare the learning event (Alinier, 2011). He or she must design or select the appropriate scenario for the students, taking into account the learning objectives and integrating the appropriate medical devices and other technology into the learning event, as well as recruiting role-players if needed (Alinier, 2011; Dieckmann & Rall, 2007). The facilitator must also have many competencies, including sufficient content-related and pedagogical knowledge (Keskitalo, 2011).

Thus, simulation-based training involves barriers that can prove to be a hindrance to learning. Dieckmann et al. (2012) have found that in the beginning of a simulation-based course, an insecure and stressed facilitator, time management problems, and unclear learning goals can affect the rest of the exercise negatively (see also Zigmont et al., 2011b). In addition, lack of commitment or inactivity on the part of the participants, or an otherwise negative atmosphere, may have unfavorable effects on the learning experience.

In their interview study, Dieckmann et al. (2012) also found that during the simulator briefing and scenario phases, insufficient preparation by the facilitator and learners can be a hindrance to learning. In addition, the participants may also be afraid of embarrassment if they are unable to provide the correct treatment. There can also be technical problems that interrupt or hamper the learning experience. Debriefing is the final phase of simulation-based training. How it goes depends, to a great extent, on the whole simulation experience, the participants' willingness to engage and reflect, the facilitator's confidence and his or her ability to guide the discussion during debriefing (see also Fanning & Gaba, 2007; Rudolph et al., 2007).

As noted, facilitators play various roles during the simulation exercise from lecturer to facilitator (Dieckmann & Rall, 2007). Therefore, teaching requires a great deal of sensitivity and perspicacity of the facilitator to adopt the appropriate role at the right time. Furthermore, the facilitator's own emotions can be a hindrance to the students' learning, since negative emotions on the part of the facilitator are usually associated with teacher-centered approaches and thus can have a negative effect on the students' performance (Trigwell, 2012). As noted earlier, high-quality simulation-based education requires a great deal of the facilitator and students as well, thereby setting requirements for proper instructor training. It is especially important to increase the understanding of educational theories (Keskitalo, 2011; Zigmont et al., 2011a), as well as how to use methods that allow for participation and activity, and how to facilitate debriefing (Østergaard, Østergaard & Lippert, 2007).

5 RESEARCH QUESTIONS

Based on the theoretical review presented in the preceding sections, the main goal of this research is to answer the following research question:

What kind of pedagogical model supports facilitation and students' meaningful learning in SBLEs?

The studies included in this dissertation are strongly based on facilitators' (n = 21) and students' (n = 136) perspectives of the learning process in SBLEs. Sub-study I comprises interviews with eight healthcare facilitators concerning their conceptions of teaching and learning, pedagogical models, methods and approaches, as well as educational tools used in SBLEs. The second Sub-study aims to understand students' (n = 97) expectations of the learning process in SBLEs. The goal of Sub-study III is to discover the conceptions of teaching and learning of healthcare facilitators (n = 13) and students (n = 30). Sub-study IV provides the theoretical background for simulation-based learning and presents the first design for a pedagogical model.

The aim of Study I was to explore healthcare facilitators' conceptions of and their approaches to teaching and learning in VR and SBLEs. Sub-study I addressed the following research question:

1. What kinds of concepts of teaching and learning, pedagogical models and methods, and educational tools are facilitators using in simulation-based learning environments?

After the first study, I became interested in students' expectations of the learning process in SBLEs. It seemed important to address healthcare students' expectations in striving to design a user-friendly pedagogical model for these environments. For this study the following research questions were set:

1. What kinds of expectations do students have concerning TSL (*teaching, studying and learning*) processes and facilitators in simulation-based learning environments?

2. What kinds of expectations do students have of their academic self-perception and the atmosphere in simulation-based learning environments?
3. Are there differences between the expectations of adults and those of young students?

Based on Sub-study I and the enthusiasm it aroused, I continued to study healthcare facilitators' and students' conceptions of teaching and learning in Sub-study III. For this study, I set the following research question:

1. How do healthcare facilitators and students view teaching and learning?

Based on Sub-studies I, II and III, as well as the previously developed pedagogical models and learning theories, the pedagogical model was designed and evaluated in Sub-study IV. We studied five simulation-based courses in Stanford University on the basis of our previously developed model. Our purpose was to detect the characteristics of meaningful learning that had not been realized, as well as to deepen our understanding of the model and how it can be applied in healthcare education. For this study, the focal point was to address the following research question:

1. From facilitators' and students' perspectives, how do facilitating and training in SBLEs foster meaningful learning by students?

As noted, each of the four sub-studies contributes to the main research task of this study. In the following chapter, I will introduce the research methods that were used during the research process.

6 METHODS

This research includes four sub-studies (see Table 2), which have all contributed to the designing of the pedagogical model for SBLEs in healthcare education. All of the studies have been reported in peer-reviewed international scientific journals. In this chapter, I present a more detailed description of the research design, including design-based research and case study approaches, the case studies and the subjects, the research contexts, data collection and data analysis. Overviews, evaluations and discussions of the studies are presented in chapters 7 and 8.

Table 2. Summary of the research design.

Aims and Research Questions	Research methods, data collection methods and research data	Data analysis methods	Publications	Contribution
Sub-study I: *Exploring facilitators' conceptions and their approaches to teaching and learning in SBLEs* What kinds of concepts of teaching and learning, pedagogical models and methods and educational tools are facilitators using in SBLEs?	**Thematic interviews** with facilitators (*n* = 8)	**Qualitative content analysis**	**Refereed international scientific journal: Keskitalo, T. (2011).** Teachers' conceptions and their approaches to teaching in virtual reality and simulation-based learning environments. *Teachers and Teaching: Theory and Practice, 17*(1), 131–147.	Insights about facilitators' views about and approaches to teaching and learning in SBLEs

Sub-study II: *Students' expectations of the learning process in SBLEs* What kinds of expectations and perceptions do students have of TSL processes and facilitators in SBLEs? What kinds of expectations do students have of their academic self-perception and the atmosphere in SBLEs	**Completed questionnaires** by students (*n* = 97)	**Quantitative analysis** using SPSS software: factor analysis (principal component analysis), reliability analysis (Cronbach's alpha), Kolmogorov-Smirnow test, means, standard deviation **Qualitative** analysis of the questionnaires' open answers	**Refereed international scientific journal: Keskitalo, T. (2012).** Students' expectations of the learning process in virtual reality and simulation-based learning environments. *Australasian Journal of Educational Technology, 28*(5), 841–856	Understanding of students' expectations about learning in SBLEs
Sub-study III: *Investigating facilitators' and students' conceptions of teaching and learning* How do healthcare facilitators and students view teaching and learning?	*Case study approach* **Six different simulation-based courses** with facilitators (*n* = 13) and students (*n* = 30) 1. Individual interviews (facilitators, *n* = 5, students, *n* = 14) 2. Group interviews (facilitators, *n* = 8, students, *n* = 16) 3. Learning diaries (students, *n* = 14) 3. Open answers of the pre- (students, *n* = 10) and post-questionnaire (students, *n* = 13)	**Qualitative content analysis**	**Refereed international scientific journal: Keskitalo, T., Ruokamo, H., Väisänen, O. & Gaba, D. (2013).** Healthcare facilitators' and students' conceptions of the learning process – An international case study. *International Journal of Educational Research, 62,* 175–186.	Deeper understanding of facilitators' and students' views about teaching and learning in general and in SBLEs
Sub-study IV: *Towards Meaningful Simulation-based Learning* From facilitators' and students' perspectives, how does training in simulation-based learning environments support the characteristics of meaningful learning?	*Design-based research and case study approach* **Five different simulation-based courses** with facilitators (*n* = 9), and students (*n* = 25) 1. Individual interview (facilitator, *n* = 1) 2. Group interviews (facilitators, *n* = 8) 3. Video recordings (facilitators, *n* = 6; students, *n* = 16) 4. Field notes (facilitators, *n* = 9; students, *n* = 25)	**Qualitative content analysis**	**Refereed international scientific journal: Keskitalo, T., Ruokamo, H. & Gaba, D. (2014).** Towards Meaningful Simulation-based Learning with Medical Students and Junior Physicians. *Medical Teacher, 36*(3), 230–239.	Defining and understanding the meaningful learning in SBLEs and designing the pedagogical model

6.1 Design-based Research Approach

The present research applied the design-based research (DBR) method (Brown, 1992; Barab & Squire, 2004; Collins et al., 2004; Design-Based Research Collective, 2003; Wang & Hannafin, 2005). DBR is typically used to refine educational practice and design pedagogical models (Barab & Squire, 2004; Wang & Hannafin, 2005; Hakkarainen, 2007; Kangas, 2010; Vartiainen, 2014), so I considered it to be an appropriate method for understanding the instructional process in SBLEs and for designing the pedagogical model to be used in these environments. DBR involves various data collection and analysis methods, which I think helps to enhance the quality of the study, give a fuller picture of teaching and learning in SBLEs, and helps to answer the multiple research questions. DBR is also in line with the ideas of socio-cultural theory since it is focused on gathering information from people in the complex social settings where the interaction and learning take place (Bielaczyc, 2013).

In this study I refer to the DBR method as the DBR approach, since in this particular case, the utilization of the method was more of an application of it, since the valuable co-designing sessions and actual refinement of the educational practice were missing. In support of this, Wang and Hannafin (2005) describe DBR as actually being more of a series of approaches than a strict method. The first three sub-studies (I, II and III) aimed to gather knowledge for the development of the pedagogical model, whereas in Sub-study IV we made the first design and thereafter the model was evaluated based on the characteristics of meaningful learning. The refined version of the pedagogical model is presented later in this dissertation (see chapter 8).

The ultimate goal of the DBR approach is to advance learning theory, educational practice and the design process (e.g., Barab & Squire, 2004; Wang & Hannafin, 2005). The idea of the DBR approach is to investigate issues in authentic settings in collaboration with researchers, educational practitioners, students and other participants. Accordingly, the researcher moves from simply being an observer to being a designer who involves other participants in the development process as co-designers. The DBR process typically encompasses the iterative phases of design, enactment, analysis and redesign (e.g., Design-based Research Collective, 2003; Wang & Hannafin, 2005).

In my case, the DBR process started with the designing of the pedagogical model based on previous research (Sub-studies I, II and III) and learning theories; thereafter, data were collected and the model evaluated at the Arcada University of Applied Sciences in spring 2009 (Case study I, see Keskitalo et al., 2010) and Stanford University in spring 2010 (Case study II). So instead of co-designing sessions in the beginning of the DBR process, I collected qualitative and quantitative data and after the analyses I designed the model based on these research results and learning theories. Co-designing sessions were simply omitted since the studies' participants had time limitations. However, what we decided during both case studies was that the existing courses would be evaluated based on the model and after the analysis, the course and the pedagogical model would be developed further. After the second case study in autumn 2013, the model was also discussed and critically considered together with three simulation educators, two educational scientists and a service designer. In this discussion we validated the model, refined it even further and discussed the future needs of simulation educators. This provided valuable information for the development of the pedagogical model. Moreover, two of the facilitators were involved as co-authors of two of the articles of this dissertation (Sub-studies III and IV). This way they have had an opportunity to get to know the pedagogical model in more detail and participate in its further development (Barab & Squire, 2004).

DBR is an approach that is linked to multiple research methodologies as it welcomes the use of multiple types of data collection and analysis methods (Wang & Hannafin, 2005). In both case studies we collected data using both qualitative (interviews, group interviews, learning diaries, field notes, video recordings) and quantitative (pre- and post-questionnaires) methods. In the final phase, after the collection of data from both studies, the pedagogical model was redesigned based on the data analysis. According to Wang and Hannafin (2005), DBR will eventually lead to context-specific and applicable design principles and theories. In this particular case, the design process will result in a pedagogical model for use in SBLEs in healthcare. The DBR approach is considered to be significant when it has advanced the theory and has had an impact on practice at the local and global levels (Barab & Squire, 2004; Wang & Hannafin, 2005). The present study was more of an application of the principles of the DBR method. To determine whether this study will have an effect will require further research. In other words, in the future we will need to be able to organize a teaching experiment where we design the learning environment and systematically change the instruction with the help of the co-designers (Barab, 2006). At present, the pedagogical model lacks the iterative cycles of implementation and refinement.

6.2 Case Study Approach

Along with the DBR approach, we applied the case study approach, as it helped us to investigate and illuminate the phenomena we are studying without attempting to affect behavior (Gray, 2004). As noted, in the present study, the DBR approach was utilized in the development of the pedagogical model along with the case study approach as a method of data collection in order to understand teaching and meaningful learning processes in SBLEs. Muukkonen-van der Meer (2011) has suggested that case studies or multiple case study research design can be utilized when explaining how the data collection and data analysis have been done during DBR iterations. For Laru (2012) the outcomes of case studies can be used to inform the instructional design and practical arrangements themselves, as well as to understand the learning processes during teaching experiments. I also think these two approaches are complementary, since both approaches study real people in real situations with multiple measures (Gray, 2004; Cohen, Manion & Morrison, 2011). Still, the DBR method tends to be more closely linked to research on learning sciences and research on learning environments (Barab, 2006).

Case studies are broadly defined in the literature (Cohen et al., 2011). Gray (2004) states that a case study can be used to investigate many topics and subjects – usually in a single instance within a bounded system. However, according to Yin (2013), a case study is empirical research that investigates a contemporary phenomenon in its real-life context, especially when the boundaries between the context and the phenomenon are not clear. Case studies tend to focus on collecting up-to-date information for the questions of how and why, using both quantitative and qualitative measurements (Cohen et al., 2011; Gary, 2004; Yin, 2013). In the present study, data were collected during two case studies at the Arcada University of Applied Sciences and Stanford University in order to understand facilitators' and students' views of teaching and learning, as well as how meaningful learning was realized from the facilitators' and students' perspectives.

It is typical of case studies for theoretical principles to direct the collection and analysis of data, so that the analysis tends to be more deductive than inductive (Gray, 2004). In the present study, previous research (Sub-studies I–III) and previous studies on meaningful and simulation-based learning, guided our data collection and analysis. By describing, illustrating and explaining this issue, we have been able to increase our understanding and widen our experience of the present phenomena, which is the main objective of the case studies (Cohen et al., 2011; Gray, 2004). Although there are many strong points with using case studies, the difficulty in generalizing them is widely noted as a weakness (Cohen et al., 2011; Gray, 2004; Yin, 2013). However, this can be compensated for by conducting multiple case studies on the same issue (Gray, 2004). In the present study, we conducted two case studies on the same issue. They are presented in more detail in the next section along with the other sub-studies of the present research.

6.3 Participants in the Studies and Case Studies

This section provides a brief summary of the participants in the study and the case studies (Table 3).

Table 3. Studies and their participants

Study	Participants
Interview study of ENVI facilitators (Sub-study I)	Facilitators (n = 8)
Questionnaire study of students (Sub-study II)	Students (n = 97)
Case Study I (Sub-study III)	Facilitators (n = 4) and students (n = 14)
Case Study II (Sub-studies III and IV)	Facilitators (n = 9) and students (n = 25)

In order to determine the current stage of pedagogical practice, thematic interviews were carried out with simulation educators (n = 8) from the Rovaniemi University of Applied Sciences (now called the Lapland University of Applied Sciences) in spring 2008. The purpose of the study was to discover the facilitators' conceptions and approaches to teaching and learning in SBLEs (Sub-study I). The facilitators' field of teaching was most commonly nursing or emergency care. Their work experience in the field averaged 18 years. Their teaching experience varied from temporary posts to 16 years, but was generally from one to three years. The facilitators had also received pedagogical training and taken short courses on the pedagogical use of information and communication technologies. I chose this interview study as a starting point since I expected that it would give me important insights into the instructional process in SBLEs, about the knowledge and expertise required by facilitators, and knowledge about the additional value of these environments.

In the second sub-study, I used questionnaires to explore students' (n = 97, 82 females and 15 males) expectations of the learning process in SBLEs. My aim was to learn about students' expectations in order to take them into account in the designing process. The study's participants were first-year healthcare (nursing, paramedics, physiotherapy, occupational therapy and healthcare) students from the Rovaniemi University of Applied Sciences and the Arcada University of Applied Sciences. The data collection was conducted in spring 2009. The participants' mean age was 27 years old, ranging from 19 to 53. The students had no or very little prior experience with simulation-based learning. The reason for selecting them was to minimize the chance that their experiences would affect their expectations.

Based on the results of these two studies and the learning theories, the first pedagogical model design was sketched out and evaluated in the Arcada Patient Safety and Learning Centre (APSLC) at the Arcada University of Applied Sciences in spring 2009 (see Keskitalo et al., 2010). Arcada was involved in the MediPeda III project, and was therefore a natural research partner. For this research, the case study yielded knowledge about the conceptions of teaching and learning, as well as suggestions for the refinement of the pedagogical model and the course (Sub-studies III and IV). The pedagogical model and the course were evaluated based on the collection of data and analysis during a seven-week course entitled *Treatment of Critically Ill Patients*. Participants included fourteen second-year paramedic students (8 females, 6 males) and four facilitators (4 males), whose specialties included nursing, paramedics and anesthesia. Most of the students had an upper-secondary school background, but some had already worked in the field. Before the study, permission to conduct the research was applied for and granted by the institutional review board. Thereafter, the students were introduced to the model and the research design, and signed consent forms. Each facilitator was introduced to the model individually and it was explained how the model could be used during the instructional process. These introductory sessions lasted about one hour. It was left to the facilitators to determine how to implement the model. Altogether, the students trained for five days in the simulation center in addition to attending lectures and engaging in periods of independent study. The course structure was as follows: Introduction, simulator briefing, scenarios and debriefing (Dieckmann, 2009b). During the training days, students worked in teams on scenarios related to the course topic: that is, the treatment of critically ill patients (e.g., heart attack patients). All in all, the students went through 11 different scenarios.

The second case study (Sub-studies III and IV) was conducted in Stanford University's simulation centers in spring 2010, as Stanford was our international research partner during the MediPeda III project. Here, the students (n = 25) were mainly second-year anesthesia residents and third- and fourth-year medical students; the facilitators (n = 9) were specialized in anesthesia, emergency medicine and nursing. Students at Stanford medical school generally study medical theory for four years. Residency training is required for them to practice in their chosen field of specialization, whereas facilitators teach in addition to doing clinical work. The youngest respondent was 26 years old and the oldest was 38. The course topics were anesthesia crisis resource management, emergency medicine, and anesthesia clerkship. The courses were structured to include an introduction, simulator briefing, scenarios and debriefing phases (Dieckmann, 2009b). Before the study, we applied to the university's institutional review board for permission to conduct the research, and permission was granted. The purpose of the research and the research design were briefly pointed out to the students and facilitators, and thereafter consent forms were filled out. We did not present the pedagogical model to the students since their days were very busy and their time was limited. For some of the facilitators, the pedagogical model was presented at a general level, but detailed explanations of its use were not given. Nonetheless, it was decided that the evaluation could be used to refine the course based on our research results and the pedagogical model.

6.4 Research Contexts of This Study

This research was conducted mostly as part of the MediPeda projects (2007–2010) and MediPro project (2012–2014). Therefore, the research environments were the same ones that were involved in those projects. The environments are described in more detail in the following.

ENVI – Virtual Centre of Wellness Campus™

The ENVI Virtual Center of Wellness Campus™ (see Figure 1) was built in the Rovaniemi University of Applied Sciences and the Lapland Vocational College (Rovaniemi, Finland) during the years 2005–2008 (for a more detailed description of the campus, see Keskitalo, 2011; www.envi.fi).

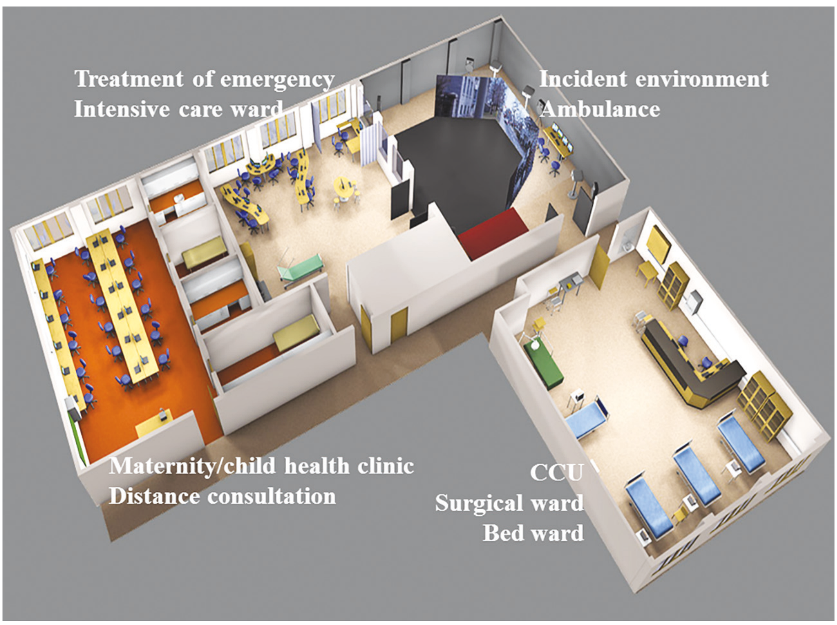

Figure 1: ENVI Virtual Center for Wellness Campus™. Published by permission of the Rovaniemi University of Applied Sciences and the Lapland Vocational College, 2010.

ENVI consists of an incident environment and a simulated ambulance, an emergency treatment and intensive care unit, a cardiac care unit, a surgical unit and a bed ward as well as a maternity/child health clinic and distance consultation room. ENVI has specifically been developed to allow personnel and students in the fields of healthcare and social services to develop, test and maintain their know-how and knowledge. For example, in the environment, students and multi-professional care teams can practice team skills during the healthcare process, from the scene of an accident to a hospital and finally to rehabilitation. Learners can also choose to practice just part of the process or basic skills in some of these spaces.

However, ENVI is not an ordinary simulation center, as it combines physical simulated environments and computer-directed interactive patient simulators with full-scale three-dimensional (3D) simulated incident environments that are completed with special effects. Learners can view, navigate and interact in the incident environment using a hand-held interaction device. Hence, the incident environment provides full-body movement in front of a large-scale display in a 3D environment (Haukkamaa, Yliräisänen-Seppänen & Timonen, 2010). This is the feature that makes ENVI unique compared to other simulation centers. However, in 2013 ENVI was still evolving, and currently it has been moved to another location. I conducted Sub-studies I and II in ENVI.

The Arcada Patient Safety and Learning Center

The Arcada Patient Safety and Learning Center (APSLC) is situated in the Arcada University of Applied Sciences (Helsinki, Finland), where the first case study and data collection (Sub-studies III–IV) were arranged together with facilitators. The APSLC is a simulation center consisting of separate rooms where students and professionals from different healthcare fields can practice specific skills or go through entire scenarios related to the content areas. It is equipped with the technology appropriate in the work of healthcare professionals. The environment includes a computer-directed patient simulator and a monitor displaying the vital signs of the patient simulator. The patient simulator is interactive and it can display different disorders, bodily functions and respirations. One room is for the facilitator, where he or she can control the simulator and guide the students' learning process via audio devices. One room is usually dedicated to debriefing, where appropriate technologies such as video and audio recording devices are available. In this room, those students who are not actively taking part in the scenario can watch the scenario through a TV screen. The center is used by Arcada's Bachelor's and Master's degree students, but continuing training courses are also offered.

Simulation Centers of Stanford University

The Patient Simulation Center of Innovation (Figure 2) is situated in the VA Palo Alto Health Care System (Palo Alto, CA, USA). The Center currently occupies around 2200 ft^2 (approx. 204 m^2). It has two large simulation rooms: one set up as an operating room and one as an intensive care unit, emergency department, or ward. The center has five computer-directed patient simulators: three permanently set up and one adult simulator for in-situ training exercises in actual clinical environments. Furthermore, it provides an infant simulator for pediatric anesthesia training. The simulation center has concentrated training on topics such as anesthesiology, intensive care and rapid response teams, emergency medicine, and respiratory therapy.

Figure 2. Training in the Patient Simulation Center of Innovation.

The simulation group at VA Palo Alto is the pioneering inventor of modern mannequin-based patient simulation. They performed their first pilot-test simulations in 1986, and have had a dedicated simulation center since 1995. They are also responsible for adapting and implementing many concepts and practices used in commercial aviation simulations to medicine. These include introducing the training of behavioral and team skills in simulations, for instance, anesthesia crisis resource management courses (*ACRM*) (e.g., Gaba, Howard, Fish, Smith & Sowb, 2001; Howard et al., 1992.)

Data were also collected at the Goodman Surgical Simulation Center, which is situated in the middle of Stanford Hospital (Palo Alto, CA, USA). The center allows for convenient drop-in practice and pre-surgical planning, while providing tools to improve learners' skills. The center was opened in June 2007. Its skills area is open 24/7 (via card access) to all surgical residents. In addition to the center's accessibility, there are two surgical education fellows in the center on a daily basis. The center has vascular trainers, virtual reality laparoscopic trainers, box trainers, colonoscopy trainers and two patient simulators.

The center offers training for a variety of learners and disciplines. It is used by surgical residents, medical students, residents from other disciplines, nursing professionals and respiratory therapists, to mention a few. Surgical residents, for example, have a weekly exercise time. During this time, they practice skills and decision making relevant to their surgical rotation in the simulation center. In Stanford University's simulation centers we conducted our second case study and data collection (Sub-studies III and IV).

6.5 Data Collection and Analysis

The aim of the present research is to understand teaching and learning in SBLEs and to design a pedagogical model for using these environments in pedagogically appropriate ways. The studies conducted during this research and learning process concentrate on different aspects of the phenomenon and the different aims of the studies have influenced the methodological choices I have made. The studies have provided a large amount of data, which is typical of DBR and case studies (Collins et al., 2004; Gray, 2004). The data provided by the research are mostly qualitative but some quantitative data have also been collected. In order to answer the research questions I set, I have collected data from both the facilitators' and students' perspectives. The data are first-hand data, which means that I collected the data by myself (Sub-studies I and II) or with colleagues (Sub-studies III and IV). A summary of the data collection and analysis methods in the four sub-studies is presented in Table 4.

Table 4. Data collection and analysis methods.

Study	Subjects	Research situation	Role of the researcher	Data collection	Sources	Data analysis methods
Sub-study I	Facilitators ($n = 8$)	Each facilitator was interviewed individually	The researcher acted as interviewer	Thematic interviews with facilitators were recorded by the researcher	Transcriptions of individual interviews	Qualitative content analysis method
Sub-study II	Students ($n = 97$)	Students filled out questionnaires	At Arcada, the researcher was not present, whereas in Rovaniemi the researcher gave instructions and was available if needed	Questionnaires completed by students	Questionnaires	Factor analysis (principal component analysis), reliability analysis (Cronbach's α), Kolmogorov-Smirnov test, descriptive statistics, qualitative analysis of open answers
Sub-study III	Facilitators ($n = 13$), Students ($n = 30$)	Students worked on scenarios related to the course topic, and facilitators were the instructors of the courses	The researchers observed and took field notes during the course	Data were collected from six different simulation-based courses	Transcriptions of individual interviews, group interviews, learning diaries, field notes, video recordings, open answers from questionnaires	Qualitative content analysis method
Sub-study IV	Facilitators ($n = 9$), Students ($n = 25$)	Students worked on scenarios related to the course topic, while facilitators were instructors of the courses	The researchers observed and took field notes during the course	Data were collected from five different simulation-based courses	Transcriptions of individual interviews, group interviews, video recordings and field notes	Qualitative content analysis method using *Atlas.ti*

In the first sub-study, I chose thematic interviews as a data collection method because the aim was to provide insights into what participants know and think (e.g., Cohen et al., 2011). I conducted these interviews with the facilitators of the ENVI environment. Each interview lasted from 40 to 80 minutes.

During the interviews I asked thematic questions I had planned in advance. The themes in the interviews included background information, the possibilities and limitations of ENVI's educational use, the basis of the teachers' pedagogical thinking, the pedagogical principles, models and methods used in ENVI, the teachers' role, the pedagogical community's strength, the need for training, and the teachers' participation in development work. In the interview I asked questions such as: *Do technology and ENVI bring additional value to instruction? How do you think people learn? What kind of role do you have as a teacher in ENVI?* I also tried to encourage free and open-ended discussion, as well as prompting the facilitators to give some detailed examples in answering questions.

Before the analysis, the research assistant transcribed the thematic interviews. I conducted the analysis using a qualitative content analysis method (Brenner, Brown & Canter, 1985; Graneheim & Lundman, 2004) according to the themes chosen. Qualitative content analysis is usually understood as a systematic and objective analysis of the visible and obvious components of a text (Gray, 2004; Graneheim & Lundman, 2004) following the rules for models of content analysis without quantification (Mayring, 2000). However, qualitative content analysis includes making judgments based on the latent content: that is, interpreting the underlying meaning of a text (Graneheim & Lundman, 2004). Usually the qualitative content analysis process includes reading the whole body of textual data several times and scrutinizing the data and separating it into categories and codes and finally into themes. The process also involves comparison between theory and data, looking for similarities and differences, and negotiation between the researchers (Graneheim & Lundman, 2004; Mayring, 2000). Qualitative content analysis gave me an appropriate tool for exploring such a multifaceted phenomenon as learning.

In the analysis of the thematic interviews, the unit of analysis was an utterance that somehow reflected the research questions. According to Chi (1997), a unit of analysis can consist of a sentence, several sentences, an idea, or an episode. During the analysis process, I scrutinized the content of each transcription in the context of the theoretical framework and the themes that I had planned in advance. The analytical process was an iterative process that involved (1) reading the data, (2) reading the data a second time and doing initial encoding with paper and pencil with respect to the research questions, (3) making short summaries of each transcription and constructing a mind map of the essential points, (4) encoding the data a second time and creating tentative categories and (5) finally specifying the categories and forming the final themes. A major feature of qualitative analysis is encoding. According to Cohen, Manion and Morrison (2011) it enables the researcher to identify similar information in textual data. A code simply contains an idea or a piece of information. In the end, the facilitators were able to comment on the research results and my interpretations. As the feedback was received, the article was changed a bit, but the actual interpretations were not called into question.

In Sub-study II, the data were collected via questionnaires from healthcare students (n = 97). The questionnaire was partially based on the *Dundee Ready Education Environment Measure* (*DREEM*) (Roff et al., 1997), which was developed to measure the educational environment of health professions (e.g., Miles & Leinster, 2007). However, for this research some questions were eliminated and some questions regarding expectations concerning studying and learning were added, since the original DREEM only examines perceptions of teaching. The additional questions were used to measure expectations of the meaningfulness of the learning (Nevgi & Löfström, 2005; Hakkarainen, 2007), which were intended to provide essential information to be used in designing the pedagogical model. Some questions were also revised for this research: for example, '*I am confident about passing this year*' was changed to '*I am confident about passing this course*'.

The revised questionnaire was tested with a group of students from the Rovaniemi University of Applied Sciences. The students had the opportunity to provide feedback on the questionnaire, and thereafter the data were analyzed to check the suitability of the questionnaire. These test questionnaires were not included in the research. The final version of the questionnaire asked the students for background information and questions related to their expectations of teaching, studying and learning processes in SBLEs. In addition, it measured the students' expectations regarding their instructor, their academic self-perception and the atmosphere. Each of the 65 statements was scored on a scale from 1 = 'the statement does not describe my expectations at all' to 5 = 'the statement describes my expectations very well'. In addition, one open question gave the students an opportunity to write about any other expectations they had.

The data were collected at the Rovaniemi University of Applied Sciences and the Arcada University of Applied Sciences. At Arcada, the facilitator told the students how to fill in the questionnaires. Facilitators were also present if the students had something to ask. At Rovaniemi, I instructed the students how to fill in the questionnaire and was present in case the students needed advice. It took about fifteen minutes for the participants to fill in the questionnaires. The participants also had an opportunity to refuse to answer or to withdraw from the study at any point. They did not receive any compensation for taking part in the study.

The questionnaires were analyzed using statistical software SPSS 15.0 for Windows. I used the factor analysis (principal component analysis) and reliability test (Cronbach's α) to make sum variables of the items on each of the six subscales.

Then I used the Kolmogorov-Smirnov test to determine whether there were differences in expectations between adult and younger students. I also reported the individual items' means and standard deviations, because I think they give valuable information about the meaningfulness of the learning process. I used the open answers on the questionnaires to further support the quantitative analysis.

Two case studies were conducted to collect data concerning the learning process in SBLEs and to evaluate and develop the initial pedagogical model further. The first case study was held at Arcada together with four facilitators and fourteen students. The data were gathered and the pedagogical model evaluated during the seven-week course *Treatment of Critically Ill Patients*. The first pedagogical model design was presented at an educational conference (Keskitalo et al., 2010). During this period, data were collected through multiple means, which is typical for DBR and case study approaches (e.g., Collins et al., 2004). Before the course, participants were given pre-questionnaires consisting of Likert-type questions concerning the expectations of the learning process in SBLEs, as well as open questions concerning the learning process and the facilitator (e.g., *What is learning? Describe learning as you understand it.*). After seven weeks, the students filled in post-questionnaires describing their experiences of the instructional process in the SBLE. During the course students also wrote learning diaries after every session in the simulation center. In their diaries they had a chance to document their experiences, thoughts, feelings and ideas about the learning process in the SBLE. For the diaries I did not give any pre-planned questions, as the aim was for the students to write out their thoughts spontaneously.

During the three final days of the course, the students and facilitators were interviewed individually. These structured interviews ranged in length from 25 to 90 minutes. I asked the facilitators questions related to their conceptions of teaching and learning (e.g., *How do you think people learn? Describe learning as you understand it.*), as well as the pedagogical model (e.g., *How did you utilize the pedagogical model in your teaching?*). The students answered similar questions about teaching and learning, whereas the questions that were linked to the pedagogical model aimed to explore the meaningfulness of the course. I also encouraged free discussion. The course was seven weeks long, so I did not have a chance to stay in Arcada and observe the whole course for financial reasons. However, the facilitators and I decided to collect video recordings of each scenario except for debriefings. The video recordings of the debriefings were left out, because the facilitator wanted the students to have an emotionally safe environment in which to critically analyze their own learning and receive and give feedback. During the three final days I observed the courses whenever I was not interviewing the participants.

Following the data collection, the data were transcribed by two research assistants. As in Sub-study I, the data were analyzed using a qualitative content analysis method (Brenner et al. 1985; Cohen et al. 2011; Gray, 2004; Graneheim & Lundman, 2004). For the purposes of Sub-study III, which aimed at gathering information concerning facilitators' and students' views of teaching and learning, I analyzed the qualitative data: open answers on the pre- and post-questionnaires, interviews, and learning diaries. I had used these methods to question facilitators and students about their views of teaching and learning.

For Sub-Study III, I combined the data collected from Arcada and Stanford University in order to get a broader picture of healthcare simulation educators' and students' views of teaching and learning (see also Keskitalo et al., 2011). In this study the analysis was an iterative and deductive process that involved reading the data the first time in order to obtain an overall picture of the phenomenon. For the second phase I chose the utterances of the facilitator or student as the unit of analysis in order to identify their views of teaching and learning. During this second phase the data were read again and meaningful utterances that related to the research questions were underlined and encoded. The second phase resulted in initial theory-driven categories (Flick, 1998). In the third phase, I created final categories based on codes that had the same underlying meanings. During this phase I re-read the data when I was unsure in which category to place a certain utterance. I also compared the categories to previous research, looking for differences and similarities. Sub-study III resulted in theory-driven categories of healthcare facilitators' and students' conceptions of teaching and learning (Flick, 1998).

The second case study and data collection (Sub-studies III and IV) were organized in Stanford University's two simulation centers. Altogether, data were collected from five different simulation-based courses (*two courses in anesthesia crisis resource management (ACRM), two courses in emergency medicine, and one course in anesthesia clerkship*), where altogether 25 healthcare students and nine facilitators participated. First, the students answered the pre-questionnaires concerning their expectations of the instructional process in SBLEs. These questionnaires were similar to those used in Arcada in spring 2009, but this time we did not have any open questions, due to time restrictions. Instead, we asked those questions in group interviews. The post-questionnaires were similar, but dealt with students' experiences of the courses. I observed the courses together with another researcher. Three of these courses were also video-recorded (*two ACRM courses and one emergency medicine course*). After every course, I interviewed the students in groups while the other researcher interviewed the facilitators in pairs. One facilitator was interviewed individually. Each interview lasted approximately 30 minutes. Before the actual interviews were conducted, we conducted pilot interviews, which gave us a chance to modify the questions. The pilot interviews were not included in the study. The actual interview consisted of questions that were similar to those asked of the participants at Arcada in 2009.

The data analysis involved transcription of the collected data by an English-language transcription service; I then used a qualitative content analysis method to analyze the data (Brenner et al. 1985; Cohen et al. 2011; Gray, 2004; Graneheim & Lundman, 2004). For Sub-study III, I combined one individual interview and the group interviews with the data gained from Arcada; the data were analyzed in the same way as described earlier. For Sub-study IV, I analyzed the interviews, video recordings and field notes from the viewpoint of meaningful learning, using the qualitative data analysis software *Atlas.ti* and a qualitative content analysis method. The unit of analysis was the utterance of the facilitator or student or the note made by the researcher reflecting the characteristics of meaningful learning (Study IV).

In the beginning of the analysis process, the transcriptions of the interviews and field notes were read twice in order to obtain an overall picture of the phenomenon. In the second phase, the transcriptions were read again, and meaningful sentences in the data were underlined and encoded according to how they related to the research questions. After this phase, we had 214 different codes.

In the third phase, categories were created from codes that had the same meaning. The transcriptions of interviews and field notes were re-read if the meaning of the code was not clear or if there was uncertainty about what name should be given to the category. Following the second coding phase, there were 32 different categories. At this point the characteristics of meaningful learning were chosen as the main categories of this study, which further decreased the number of categories to 14. The omitted codes dealt with conceptions of teaching and learning, and they were used in Sub-study III. During the final phase, the fourteen categories were connected as described in the introduction, and final themes were created based on the research questions and coding process. In this phase, the video recordings were used as a source of supplementary data. The video recordings were watched and compared to theory-driven categories and themes in order to see if the video recordings supported the categorization and thematization that were made based on the textual data. The characteristics of meaningful learning that had been supported during the training received more favorable comments than those that had received only partial support.

7 SUMMARIES AND EVALUATION OF THE SUB-STUDIES

The present study explores simulation-based learning and aims to design a pedagogical model for SBLEs in healthcare. This chapter provides both a summary and an evaluation of the main findings of the sub-studies (I–IV) which I conducted during this research and my learning process.

7.1 Sub-study I: Exploring Facilitators' Conceptions and Their Approaches to Teaching and Learning in SBLEs

Keskitalo, T. (2011). Teachers' conceptions and their approaches to teaching in virtual reality and simulation-based learning environments. *Teachers and Teaching: Theory and Practice, 17*(1), 131–147.

The starting point for designing the pedagogical model for SBLEs in healthcare was research that aims to understand how the facilitators (n = 8) who have been teaching in ENVI, or have been considerably involved in its development, perceive teaching and learning in an environment like ENVI. The specific aim was to find out on what grounds facilitators based their teaching and what educational tools and pedagogical models and methods they use in their teaching. With that in mind, the purpose was to start building a pedagogical model for these novel learning environments. When starting this research, I noticed there was only sparse information available about healthcare facilitators' conceptions of teaching and learning in SBLEs, compared to the research that was available on higher education teachers' and grade school teachers' conceptions of teaching and learning (e.g., Bruce & Gerber, 1995; Kember & Kwan, 2000; Postareff & Lindblom-Ylänne, 2008; Postareff, Lindblom-Ylänne & Nevgi, 2007; Trigwell & Prosser, 1996), which have been studied quite extensively since Roger Säljö (1979) published his first categorization of conceptions of learning. The lack of and consequent need for this kind of research was clear to me and triggered my enthusiasm to study this topic further in Sub-study III (Keskitalo et al., 2011; Keskitalo, Ruokamo, Väisänen & Gaba, 2013).

Analysis of thematic interviews with facilitators revealed that teaching was viewed mostly as a means to facilitate students' learning. However, the facilitators viewed themselves also as experts of the content knowledge, which they felt was important to disseminate to the students. Furthermore, they often mentioned problems in integrating theoretical and practical knowledge, which facilitators tried to solve by using real-world examples. In this study, the conceptions of learning were more varied among the participants. According to the facilitators, learning occurs through students' acquisition of knowledge, doing, and exploring and constructing the knowledge and skills that they will need in their future careers. Moreover, the participants viewed learning as an individual process.

These conceptions became evident in teachers' approaches to teaching as well as their utilization of problem-based learning (*PBL*), which was the most frequently cited pedagogical approach. Simulation-based courses were structured to include an introduction, simulator briefing, scenarios and debriefing phases (Dieckmann, 2009b; Joyce et al., 2002). However, there were also some facilitators who did not mention any of the pedagogical models or methods, but rather based their teaching on the student group or the teaching objectives. In order to emphasize students' individuality, the facilitators utilized a variety of pedagogical methods in their teaching. These ranged from lessons to group work and role-play.

In addition to using ENVI in their teaching, facilitators used traditional educational tools such as written material, PowerPoint slides and network-based learning environments (*Optima, LearnLinc, Moodle*). In this study, the facilitators really valued ENVI, frequently mentioning that it has brought authenticity to their teaching. In practice, this means that students can put theory into practice in a safe, realistic environment and see how it works without being afraid of making mistakes. Despite the many benefits ENVI has brought, there were also challenges confronted by the facilitators. First of all, facilitators should overcome their own fears related to teaching in the environment; consequently, open-mindedness and desire to develop were mentioned as important characteristics of facilitators. Facilitators stated that while teaching, they should be familiar with the subject matter and medical technology. Pedagogical knowledge was also considered as important as it helps to actualize the instructional process smoothly. Furthermore, the facilitators stated that fewer students in the class during simulation-based training would be more beneficial for teaching and learning.

One overriding strength of this study was that it provided insights into a rather unexplored topic. In this study, I interviewed eight facilitators, which is a rather small number of participants. However, that was the number of ENVI facilitators available at the time, although simulation-based education tends to be usually rather small-scale (Helle & Säljö, 2012). The point of the thematic interviews was to find out what a particular facilitator knew and thought about this topic (Cohen et al., 2011). In addition, I selected this method because I did not want to restrict the discussion too much. With a thematic interview I was able to modify questions, explain what I meant, change the wording or ask a new question if the answer of the participant prompted some new ideas or questions (Cohen et al., 2011).

The method of self-reporting is commonly used in educational studies and especially in studies that have tried to detect conceptions of teaching and learning (cf. Kember, 1997). However, this method may not always be the best choice. First of all, the interview questions may be interpreted differently and the participants may have provided answers to a different question than the one being asked. Moreover, the analysis is based on the wording of interviewees' responses, which they may not notice themselves since interviews are usually considered as a two-person conversation (Cohen et al., 2011). To counterbalance the danger of misinterpretation, I enhanced the trustworthiness of the study by letting participants comment on my interpretations (Graneheim & Lundman, 2004). However, I did not receive any comments that were crucial for my data analysis.

To summarize, this study indicates that healthcare facilitators consider themselves as facilitators of students' learning, whereas learning was seen as a more varied process. Facilitators had many strategies to execute teaching in ENVI, which featured a student-centered approach to teaching and learning. Participants also highly appreciated the SBLEs. At the same time, simulated environments place demands on facilitators. They have to have strong expertise in the subject matter and in the use of the technology of the environment. Pedagogical knowledge was also considered to be important. The research convinced me that facilitators could benefit from a pedagogical model designed for SBLEs that could guide healthcare educators in designing their teaching, and this could be particularly useful for those facilitators who do not use any pedagogical aids. As these innovative learning environments are rarely designed with learning theories in mind, they do not necessarily ensure efficient learning (cf. Helle & Säljö, 2012; Hämäläinen & Häkkinen, 2010).

This study started my learning process and was a first step in the development of the pedagogical model for SBLEs in healthcare education. It provided valuable information about facilitators' conceptions of teaching and learning, and their approaches to teaching as well as knowledge about the pedagogical use of ENVI. In addition, the study provided insights into what kind of support facilitators need for their teaching and, for example, what such a learning environment demands of the facilitators and how facilitators should develop their own expertise. Currently, we do not fully know how learning occurs in this type of environment, nor how to optimize that learning (e.g., Cook et al., 2011; Helle & Säljö, 2012). Thus, this study has contributed to the current discussion about the pedagogical use of simulations and has provided guidelines concerning the directions in which we need to take the theory and pedagogical model. For the development of the pedagogical model, this study clearly emphasized the teachers' roles as facilitators of students learning, which in turn necessitates students' own activity. Furthermore, this study brought to the forefront certain features of meaningful learning (e.g., *active, individual, contextual, socio-constructive*) as well as the simulation-based learning models (Dieckmann, 2009b; Joyce et al., 2002). As a great motivator and starting point for the development and research process, Sub-study I aroused my curiosity about students' expectations, which I took into account in the next study (Sub-study II).

7.2 Sub-study II: Students' Expectations of the Learning Process in SBLEs

Keskitalo, T. (2012). Students' expectations of the learning process in virtual reality and simulation-based learning environments. *Australasian Journal of Educational Technology, 28*(5), 841–856.

This sub-study represents a second step in designing the pedagogical model for SBLEs. Here, I report on a study of students' expectations of the learning process in SBLEs. By better understanding these expectations, we can design the educational environment to correspond better with students' needs and expectations. Research related to students' expectations of the learning process in SBLEs was also absent at the time I made the research. The following research questions were set in the beginning of the study: (1) *What kinds of expectations do students have about teaching, studying and learning processes and facilitators in SBLEs?*, (2) *What kinds of expectations do students have of their academic self-perception and the atmosphere in SBLEs?*, and (3) *Are there differences between the expectations of adults and those of young students?*

I collected the empirical data from the Arcada University of Applied Sciences and the Rovaniemi University of Applied Sciences in spring 2009 using a questionnaire. Altogether 97 first-year healthcare students participated in this study. The statistical analysis pointed to the following six sum variables expressing students' expectations:

1. Inspiring and individually tailored teaching,
2. Individual and competence-based studying,
3. Transferable learning outcomes,
4. Competent and well-prepared facilitators,
5. Confident and competent students (academic self-perception), and
6. A relaxed and comfortable atmosphere

Inspiring and individually tailored teaching depicts the students' expectations about the teaching in SBLEs. Most often students expected that teaching would help to develop their competence, would be stimulating, and that their needs would be taken into account. Expectations were high about studying, too. The sum variable *Individual and competence-based studying* indicated that students expected they would be able to utilize their prior knowledge, set their own learning goals as well as familiarize themselves with the equipment they would need in their future work. From learning, students expected transferability, as the sum variable *Transferable learning outcomes* depicts. Analysis of the individual items revealed that most often students expected to learn things that were applicable and that learning would help them understand things. After the course, students expected they would know how to use the equipment and they would be highly skilled. Again, students' expectations were high regarding the facilitator: 33% of the students expected quite a lot, and 26.8% a lot from their instructors. What the students expected was that the facilitator would be competent, well prepared for teaching, and would give clear examples. Therefore, I named the sum variable *Competent and well-prepared facilitators*.

This study also measured students' expectations regarding their academic self-perception and atmosphere. I named the sum variable that measured students' academic self-perception *Confident and competent students*, since students were especially certain that they could manage different kinds of exercises and that they would pass the course. Students expected the atmosphere in the SBLEs to be relaxed and comfortable and that unsure students would get help. I therefore named the sum variable *Relaxed and comfortable atmosphere*. Overall, the students seemed to have high expectations of the activities in SBLEs. Especially adult students seemed to expect a lot compared to younger students. In all cases, over half of the students expected quite a lot or a lot from the learning process in SBLEs. On average, students' highest expectations seemed to be regarding learning and facilitators.

There were 97 first-year healthcare students from the two institutions involved in the study. The questionnaires were distributed to students who only had a little experience with training in SBLEs. The intention was to guarantee that students' experiences would not affect their expectations. The data were analyzed using factor analysis (*principal component analysis*) and reliability analysis (*Cronbach's alpha*). The Cronbach's alpha for the study's subscales was in each case quite high (0.825–0.897), which indicated an acceptable internal consistency and that the variables could be used to describe students' expectations (Nunnally, 1978). The study's target group was also quite consistent, because the gender distribution was the same as the distribution normally present in healthcare education in Finland (Saarenmaa, Saari & Virtanen, 2010). However, the uneven distribution of genders was also the reason why I did not attempt to figure out differences in expectations between them.

Even though the study's results are somewhat descriptive, this research gave me useful information about students' expectations concerning the learning process in

SBLEs, because we do not currently know much about students' expectations of simulation-based healthcare education. Previous research has concentrated more on the students' experiences and development of education based on those experiences. Knowledge about students' expectations is especially important since expectations affect the forthcoming learning event, and can set the tone for the whole simulation exercise – affecting it positively or negatively (Dieckman & Yliniemi, 2012). Usually, expectations tend to be higher than experiences (Miles & Leinster, 2007).

From this study I was able to derive several implications for healthcare education practices and especially for the development of the pedagogical model. Overall, this study brings to the forefront the various characteristics of meaningful learning (e.g., *experiential, experimental, socio-constructive, competence-based, contextual, goal-oriented, self-directive, individual*) that should be taken into account during the instruction. For example, the study's results suggest that although collaborative studying in SBLEs is fun and quite often effective (Helle & Säljö, 2012; McGaghie et al., 2010), we should also pay special attention to individuals, for example, in the form of individual counseling sessions or individualized instruction. Moreover, value should be placed on tasks and problems that originate in real life. During this problem-solving process students would learn competencies that are of real value in working life. For facilitators, this research has high demands. They should be pedagogically and professionally knowledgeable as well as well prepared. This research confirmed the notion that these environments do not teach on their own; instead, the facilitator has the focal role in the environment as well as before the instruction while preparing the learning event, the material, tasks and the evaluation. Therefore, this study suggests that additional importance should be placed on facilitators' preactivities. In addition, these research results are valuable for healthcare educators by helping them take students' expectations into consideration while planning and implementing teaching in SBLEs.

7.3 Sub-study III: Investigating Facilitators' and Students' Conceptions of Teaching and Learning

Keskitalo, T., Ruokamo, H., Väisänen, O. & Gaba, D. (2013). Healthcare facilitators' and students' conceptions of the learning process – An international case study. *International Journal of Educational Research, 62,* 175–186.

The purpose of Sub-study III was to investigate the facilitators' (n = 13) and students' (n = 30) conceptions of teaching and learning. The specific research question was as follows: *How do healthcare facilitators and students view teaching and learning?* In this study the data were gathered from the Arcada University of Applied

Sciences and Stanford University using multiple methods, including individual interviews, group interviews, students' learning diaries, and students' open questions in pre- and post-questionnaires. Initially, the data collected from Arcada were analyzed separately and the results were presented at an educational conference (Keskitalo et al., 2011). For this dissertation the Arcada and Stanford data were combined and analyzed together (Keskitalo et al., 2013). The conference article describes the phenomenon at a more general level, whereas in the journal article I have formed the categories of the conceptions of teaching and learning.

As a result of the qualitative content analysis, we elaborated three distinct theory-driven categories of conceptions of teaching and learning as well as two categories describing the teaching in SBLEs. The categories of conceptions of teaching were: 1) *Teaching as communicating knowledge and skills to students*, 2) *Teaching as development of students' skills and understanding*, and 3) *Teaching as facilitation of students' learning*. In the first category, the focus was on facilitators and the expertise that they tried to disseminate to the students. Within this category, students were seen as being rather passive. In the second category, the facilitator moved closer to the students and tried to make the information more understandable for them by modeling and explaining. However, the facilitator remained the person who directed the learning and decided the content to be studied. In the third category, teaching was seen as facilitation of the students' learning. The focus was on students and their learning, whereas facilitators were considered more like a resource for students to benefit from.

Analysis of the statements concerning teaching in an SBLE revealed two broad categories of conceptions of teaching: 1) *Teaching in an SBLE as communication of knowledge and skills*, and 2) *Teaching in an SBLE as facilitation of students' learning*. Within the first category, the facilitator was the one who directed the learning and showed the correct ways to practice skills. Interestingly, this category was more popular among the facilitators. In the second category, teaching was viewed as facilitation of students' learning and was more common among the participants. Within this category, the facilitator is depicted as one who creates opportunities for learning and fades into the background, giving students freedom to practice their skills and knowledge and come to their own conclusions with the help of their peers and the facilitator.

As the iterative data analysis proceeded, I was able to identify three distinct categories of conceptions of learning, namely: 1) *Learning as acquiring and reproducing knowledge and skills*, 2) *Learning as advancing and applying knowledge and skills*, and 3) *Learning as a transformative process*. The focus of the first category was on learning the content using different kinds of study strategies. After learning, students know more and know how to perform certain tasks, but they do not particularly know how to apply their knowledge. Of these categories, the second was the most common. In this category, the focus was on students and the development of their competence. Here, there was a clear purpose for acquiring knowledge and skills, such as applying them to solve complex medical problems. Finally, a third, less common, category existed. It emphasized experience and critical thought during the learning process. Within this category, learning was perceived as a fundamental and life-long process, thus resembling the socio-constructive conceptions of learning.

In this study, I tried to go a step further and figure out if there were more categories of conceptions of teaching and learning than previous studies had generated (Bruce & Gerber, 1995; Boulton-Lewis, Smith, McCrindle, Burnett & Campbell, 2001; Kember, 1997; Keskitalo, 2011; Postareff & Lindblom-Ylänne, 2008). It was hypothesized that there could be more categories since there was sparse research available on healthcare teachers' and students' conceptions of teaching and learning. There was also no research available concerning conceptions of teaching and learning in connection with the use of SBLEs in healthcare education.

Contrary to our expectations, this study yielded quite typical conceptions of teaching and learning. However, the participants' conceptions were quite sophisticated, since teaching was viewed mostly as facilitation of learning, and learning as the application and advancement of knowledge and skills. As previous research has noted, a professional orientation seems to be the dominant viewpoint in healthcare education (Lindblom-Ylänne & Lonka, 1999). Furthermore, this study confirmed that the conceptions seem to form a hierarchy rather than a continuum (Paakkari, Tynjälä & Kannas, 2011; Tynjälä, 1997; Säljö, 1979). This became evident with participants expressing more than one conception depending, for example, on the students' characteristics.

The data for Sub-study III were gathered through multiple means, thus data triangulation is one of its strengths. The rather large number of participants is another strong point of this study, since studies conducted about simulation-based learning are usually quite small in scale (Helle & Säljö, 2012). In Case studies I (Arcada University of Applied Sciences) and II (Stanford University) we used slightly different kinds of data collection methods. For example, in Arcada we collected learning diaries as well as open answers on the pre- and post-questionnaires, but in Stanford those were missing due to time restrictions. In Stanford we collected data in group interviews instead of individual interviews in order to save participants' time. This uneven distribution of data collection methods affects the interpretation of the studies' results. For example, with the Stanford data we were unable to detect individual views, which would have enabled us to make comparisons between conceptions of teaching and learning or even detect more or different kinds of categories. Furthermore, the large amount of data is typical for DBR and case study approaches (Collins et al., 2004; Gray, 2004), but can be overwhelming. It is common for there to be more data than there is time to go through during the research process.

With self-reporting methods, there is a danger that the questions are interpreted differently than the researchers anticipated; therefore, the participants may have been addressing slightly different issues in their answers. This was potentially the case when we were interviewing English-speaking participants, as English is not our native language (Cohen et al., 2011). Furthermore, I based my interpretation on the wording of interviewees' responses. However, the interviewees themselves do not necessarily pay much attention to the words that they use (Kember, 1997). As the research progressed, I noticed one additional downside of our inquiries. We should have asked questions about knowledge, since conceptions of teaching and learning are also related to conceptions of knowledge (Entwistle & Peterson, 2004; Kember, 2001; Paakkari et al., 2011). Because of our experiences, we modified our questionnaires to include questions dealing with conceptions of teaching and learning as well as questions that address conceptions of knowledge.

This study yielded information about the conceptions of teaching and learning in general, and more specifically in SBLEs, both from facilitators' and students' points of view. Despite the many insights this study gave me, there are still questions that remain unanswered and need further investigation. For example, the question of whether these conceptions form a strict, well-defined hierarchical system or whether the boundaries of the categories are blurred remains unsolved. In this kind of research, if we want to detect and compare individual opinions, we need to collect data that enable us to detect individuals' views. Moreover, with a larger group of participants, it would be possible to see if there are as many common conceptions between the different contexts as this research suggests. In future studies, it would also be interesting to quantify the results in order to see which conceptions are more common in simulation-based healthcare education. Furthermore, it would be interesting to find out which conceptions are related to successful studying or good clinical performance. At present, the results of the studies are quite descriptive in nature.

The results of this sub-study suggest that there might be students who still 'wait to be told', since teaching was seen as communicating knowledge and skills to students and learning as acquiring and receiving information. Consequently, these students may feel uncomfortable with new learning environments and pedagogical methods (cf. Kember, 1997) which are intended to promote activeness and self-directedness in learning. For simulation-based learning this means that learners should be instructed properly and special emphasis should be placed on creating a supportive and emotionally safe atmosphere for the exercise (Dieckmann et al., 2012; Dieckmann & Yliniemi, 2012). Thus, special emphasis should be placed on students' individuality and proper instruction.

On the other hand, facilitators may feel challenged if they find they have differing views and expectations from students concerning methods and requirements of teaching and learning in the learning environment (Trigwell, 2012), which is something facilitators would need to reflect on. However, previous research has found that introducing new learning environments with appropriate pedagogical methods, long-lasting pedagogical education, as well as time and support are factors that can influence our conceptions and point them in a more student-centered and learning-focused direction (Entwistle & Peterson, 2004; Kember, 2001; Keskitalo, 2011; Lonka, Joram & Bryson, 1996; Postareff et al., 2007; Tynjälä, 1997), which will eventually lead to teachers' innovative use of technology (Drent & Meelissen, 2008).

Overall, Sub-study III pointed to the need for special emphasis to be given to students' individuality. Furthermore, the study confirmed the importance of the roles of facilitators in students' learning. It also brought to the forefront the importance of facilitators' postactivities: that is, reflection on their own conceptions and approaches to teaching that might have an effect on their instruction (Entwistle, Skinner, Entwistle & Orr, 2000; Trigwell, 2012).

7.4 Sub-study IV: Towards Meaningful Simulation-based Learning

Keskitalo, T., Ruokamo, H. & Gaba, D. (2014). Towards Meaningful Simulation-based Learning with Medical Students and Junior Physicians. *Medical Teacher,* 36(3), 230–239.

The purpose of Sub-study IV was to evaluate five simulation-based courses at Stanford University based on the previously developed pedagogical model, especially from the viewpoint of meaningful learning. My intent was to go deeper into the characteristics of meaningful learning. Therefore, in the original publication (Keskitalo et al., 2014), I have tried to clarify more precisely what these specific characteristics mean and how they can be implemented in this kind of context in order for simulation educators to understand and apply them properly. In this study the specific research question was: *From facilitators' and students' perspectives, how does facilitating and training in SBLEs foster meaningful learning by students?* For this purpose, we collected data from facilitators (n = 9) and students (n = 25) using multiple methods.

The results suggest that simulation-based learning can be considered to be meaningful even though the facilitators were not instructed to follow a certain model. It became evident that simulation-based learning is fundamentally meaningful since it inherently supports many characteristics of meaningful learning.

However, we have noticed (Keskitalo et al., 2010) that some characteristics need more attention and support. The *goal-oriented*, *self-directed* and *individual* characteristics seem to be those that often limit the meaningful learning experience.

In the evaluated courses, formal articulation of the learning goals was poor, which in turn prevented students from setting their own learning goals. Therefore, in order to realize the *goal-oriented* characteristic, in future simulation-based courses the goals should be stated clearly, and they should be reflected on during the debriefing process. Furthermore, participants could benefit from setting their own learning goals or maybe setting learning goals collaboratively. To aid *self-directed* learning, facilitators could help students follow and evaluate their learning, for instance in debriefing, which helps in attaining their learning goals and setting new ones. Simulation-based learning is usually a collaborative undertaking; however, learning is individual (De Corte, 1995) and there might be students who expect more *individualized* feedback and guidance (cf. Keskitalo et al., 2010; Keskitalo et al., 2011): for example, how well or not so well they performed during the scenario and how they should develop themselves further in becoming professionals.

This study had both strengths and weaknesses. A clear strength of the study was that the research and data collection were designed together with the course organizers and facilitators. Hence, the experiments went smoothly and we did not confront sudden changes or other surprises, despite the cancellation of a few courses. Technology is typically challenging but was a clear strength in this study, because the simulation centers had a dedicated person who operated the simulators and other related equipment, such as video recorders. This was the reason why video recordings were carried out systematically and from different viewpoints. In addition to video recordings, this study produced other kinds of data, which is another of its strengths. However, large amounts of data can also overwhelm researchers (Barab & Squire, 2004; Collins et al., 2004).

The facilitators' commitment to the experiment (despite their many obligations) was a definite strength of the study. They really valued the importance of group interviews and took time to reflect on their teaching from a pedagogical viewpoint. Although we did not instruct facilitators in a detailed way to follow a certain model, we might have made an impression on them; in the future they might think about their teaching from a more pedagogical viewpoint. Some of the facilitators also had a chance to become familiar with the model during the short presentation we gave in Stanford. One of the authors of the article connected with this substudy has led the simulation group in Stanford for a long time, which provided us with a good opportunity to further discuss and develop the simulation pedagogy.

However, this study also had some weaknesses. One basic weakness was that despite our expectations, we did not have time to familiarize the participants with how to use our model. This was due to the many other obligations they had. So the use of the DBR method was again inadequate. For that reason, the present research is best described as a case study. During this case study we decided to evaluate the courses from the viewpoint of our model, and to redesign it further based on the data and the analysis process. The participants' lack of time was also the reason why we ended up conducting group interviews as a data collection method. The students had tight schedules with other obligations, and that is why they had limited time to use in this study.

Another weakness was that during the experiment there were too many theoretical viewpoints to control. For example, the observations were difficult, because observing the activity of the students from the viewpoint of fourteen characteristics of meaningful learning was quite challenging. However, in this task the video recordings were helpful, as was the presence of the other observer (the second author of the article). Moreover, the simulation-based courses were rather small-scale, as there were usually around six participants in one course. While this small number is considered to be beneficial for efficient learning in simulation settings (Keskitalo, 2011), quality research often requires a larger number of participants. This contradiction can be a shortcoming in studying simulation-based learning, especially with quantitative means. In this research, we solved this problem by applying a case-study approach and using different kinds of data collection methods and collecting data from facilitators and students in various locations and from different kinds of courses.

The goal of this study was to evaluate five simulation-based courses from the viewpoint of the developed pedagogical model, and especially the characteristics of meaningful learning. The results of this study suggested many implications for practice and the development of the pedagogical model. As noted, simulation-based learning is inherently meaningful, although some characteristics (*individual, goal-oriented*, *self-directed*) might need special attention in this respect. However, Jonassen (1995) stated that learning can be meaningful even without all of these characteristics being present all the time. In the future, we need to continue the research where the aim is to determine *meaningful simulation-based learning characteristics* that are particularly important in these settings. In addition, the implementation of the research warrants modification for the future running of the studies and their arrangements. For example, in order to conduct a proper teaching experiment, it is important that participants have enough time for this kind of development work. Based on the research results of Sub-study IV, the pedagogical model was again developed further; the refined version of the model is presented in the following chapter.

8 THE PEDAGOGICAL MODEL *for* SIMULATION-BASED HEALTHCARE EDUCATION

The aim of this chapter is to connect theoretical insights concerning learning and the empirical studies undertaken as part of this study into a pedagogical model. Suitable pedagogical models are needed if we are going to optimize the use of simulation-based learning environments for educational purposes (Cook et al., 2011; Helle & Säljö, 2012). What is special about the pedagogical model presented here is that (1) the socio-cultural context surrounds the pedagogical model in order to remind us of the complexity of learning and the development of expertise; (2) I have embedded the main phases of simulation-based learning – *Introduction, Simulator and Scenario briefing, Scenarios* and *Debriefing* (Joyce et al., 2002; Dieckmann, 2009b) – in it, (3) in addition to pre- and postactivities of the facilitator and students, (4) which are completed with fourteen characteristics of meaningful learning, which were selected based on theories and empirical studies, and (5) the previous research results of the present study (Sub-studies I–IV). In addition, (6) I have designed the model with a specific context – that is, SBLEs – in mind. The pedagogical model is presented in Figure 3.

Figure 3. The pedagogical model for simulation-based healthcare education.

As the pedagogical model suggests, we should consider learning in a broader socio-cultural context (Säljö, 2004; 2009; Palincsar, 1998; Vygotsky, 1978). This means that learning does not happen in a vacuum; rather there is constant interplay between the individual and social factors (Säljö, 2009). From this perspective we can start to understand the complexity of learning and development and how the tools, practices and institutions are also transformed within this interplay (Palincsar, 1998).

The characteristics of meaningful learning are the core theoretical component of the pedagogical. The characteristics of meaningful learning can be considered as ideal goals for creating learning experiences. These fourteen characteristics can help facilitators harness SBLEs for meaningful learning and shed light on things facilitators might not otherwise consider. With these theoretical viewpoints in mind, facilitators might consider facilitating and training processes from a broader perspective in order to develop even more innovative pedagogical practices.

In the pedagogical model, the learning process is scripted into *Introduction, Simulator and Scenario briefing, Scenarios* and *Debriefing* phases as suggested by previous pedagogical models (Dieckmann, 2009b; Joyce et al., 2002; Laurillard, 2012). These phases can help facilitators structure the learning events. Furthermore, the pedagogical model reminds facilitators and students of their important tasks before and after the simulation activity. In the following paragraphs, I will present the main phases of the pedagogical model in more detail.

1 Preactivities. Kansanen et al. (2000, p. 1) have divided the teacher's activities into the *preactive phase*, the *interaction proper*, and the *postinteractive phase*. This means that there are also activities before and after the actual teaching. In the pedagogical model (see Figure 1), the facilitator's tasks in the *preactive phase* include, for instance, designing the learning process and learning environment with specific learning objectives and student characteristics in mind (see also Alinier, 2011). Furthermore, we suggest that the facilitator should consider the characteristics of meaningful learning when planning, realizing and evaluating student activities. Students' activities in the preactive phase include familiarizing themselves with the subject matter; activities in this phase usually include preassigments, reading or lectures. In this pedagogical model the interaction proper includes the following phases: introduction, simulator and scenario briefing, scenarios and debriefing, which are presented below.

2 Introduction – Activating Prior Knowledge and Setting the Ground. In the first phase of the actual simulation-based learning process, the facilitator presents the course topic and its objectives and the most important concepts, as well as explaining the concept of simulation to the students, including its advantages and disadvantages (Dieckmann, 2009b). Merrill (2002) states that learning objectives are usually communicated as statements of abstract objectives. However, for better orientation in the simulation-based learning process and in order to help the learners form the mental representation of the desired behavior, it would be better if they are shown what they will be able to do after the instruction (de Leng, Dolmans, van de Wiel, Muijtjens & van der Vleuten, 2007; Merrill, 2002). This can be done, for example, by modeling the behavior or showing a video related to the learning objectives (de Leng et al., 2007). The introductory phase should also include explanations of how the course is organized, as well as what pedagogical models and methods are being used.

From the students' viewpoint, the purpose of the first phase is to activate the previous knowledge base and experiences that can be used as a foundation for new knowledge as suggested by the socio-constructive and experiential characteristics of meaningful learning. Activation of previous knowledge is also necessary for the formulation of the learning goals (Dolmans et al., 2005). If the students lack the appropriate knowledge and skills, then the facilitator's task is to provide the students with sufficient knowledge (cf. *theory input* Dieckmann, 2009b). In the present research, the Finnish students (case study I) had lectures before beginning the simulation exercise, whereas the American students (case study II) usually had done prior reading. Therefore, what is important in simulation-based learning environments is activating prior knowledge and skills. Arousing previous knowledge can be done by writing, asking questions, writing down questions about the topic, discussing, sharing experiences, inventing analogues, constructing a concept map and complementing it later, and other activities (Graffam, 2007; Lonka & Ahola, 1995; Merrill, 2002). As noted, a variety of methods and tools may be used to this end. By the end of the introductory phase, students should have reflected on their previous knowledge and experiences and be familiar with 1) the topic, 2) the learning objectives, 3) simulation-based learning in general, and 4) pedagogical models and methods, as well as the ground rules, e.g., confidentiality issues.

3 Simulator and Scenario Briefing – Familiarization. During the second phase, participants begin to enter into the simulation. This is the phase in which the facilitator introduces the scenario – that is, the patient case – and the simulation-based learning environment, including all the technology the participants will be required to use. It is good for the participants to be aware and critical of the differences between the simulator and a real patient, because we cannot simulate everything. Therefore, this phase should involve a demonstration and hands-on exercises (Dieckmann, 2009b). When introducing the scenario, the facilitator can use problems or real-world examples as learning triggers (Davis & Harden, 1999). This helps the participants get in the right mood for the exercise and understand why training is being done on this particular topic and in this particular way (Dieckmann et al., 2012). This also helps with the learning transfer. This phase should include the introduction of the goals of the simulation exercise, the participants' roles and the rules during the exercise. Procedures and any decisions the participants will be required to make should be introduced at a general level so that we do not spoil the surprise and the simulation experience (Alinier, 2011). It is important that students feel challenged by and motivated for the rehearsal (Laurillard, 2012). Dieckmann (2009b) has proposed some questions that help in creating an understandable scenario:

- Who is acting?
- What is being done?
- Where does the situation take place?
- Why did this evolve?

- Which motives do people follow?
- What do people want to obtain?

Towards the end of this phase, the students need to know and understand what is expected of them so that they can settle into their roles and engage in the exercise properly (Dieckmann & Yliniemi, 2012). It is also important that students have learned to use the system. During this phase students are also encouraged to set their own goals for learning (Keskitalo et al., 2010; 2014), or the learning objectives can also be set collaboratively. This is important for the realization of the individual, goal-oriented and self-directed characteristics of meaningful learning.

4 Scenarios – Guiding and Participating. Phase three forms the core of the simulation-based learning experience during which students participate in the simulation. During this phase the students are active in treating the patient, while the facilitator stays in the background to some extent. In this phase it is important for the facilitator to state explicitly when the scenario starts and ends. The participants are usually quite engaged in hands-on experiencing, but at the same time they may be afraid that the exercise will expose their lack of personal competence (Dieckmann et al., 2012). Therefore, establishing an emotionally safe environment early on is crucial.

5 Debriefing – Facilitating and reflecting. As mentioned earlier, there are different models available for conducting the debriefing (Dreifuerst, 2012; Dufrene & Young, 2014; Fanning & Gaba, 2007; Rudolph et al., 2007; Steinwachs, 1992; Zigmont et al., 2011b). Basically, during the debriefing process, the students are responsible for reviewing and reflecting on the learning process as well as identifying their knowledge gaps and forming new learning objectives, whereas the facilitator's role is to be a "cognitive detective" (Rudolph et al., 2008, p. 1011). In this phase the facilitator encourages the students to analyze the entire experience in order to enhance their learning and future practice by asking questions such as (Fanning & Gaba, 2007; Keskitalo et al., 2014; Rudolph et al., 2007):

- How did the scenario go?
- What were you thinking and feeling?
- What problems did you encounter and why?
- What else could you have done?
- How was the learning process?
- Did you attain the learning goals?
- What have you learned and why?

In the debriefing phase, it is also important to compare the simulation to the real world, because students need to understand how the knowledge and skills they have learned are affected by the use of simulations (Lane et al., 2001) and how simulations differ from real life. Individualized feedback and emotional support should also be offered (Dieckmann et al., 2012; Keskitalo, 2011; 2012; Keskitalo et al., 2010; 2014; Zigmont et al., 2011b), since individualized and precise feedback is essential for the development of expertise (Ericsson et al., 1993), and this is also true for the realization of the individual and self-directed characteristics of meaningful learning. During the debriefing, video recordings are widely used, but it should be borne in mind that other tools and methods, such as learning diaries, are also available.

6 *Postactivities.* From the facilitator's viewpoint, the critical evaluation of the whole instructional process takes place after the interaction, during the *postactivities phase* (cf. Keskitalo et al., 2010). This means that the facilitator should consider the facilitation process itself and students' activities, as well as whether the learning objectives have been achieved, in order to develop his or her instruction. The facilitator's postactivities are important for the development of simulation-based education and the development of the facilitator's own role as a healthcare facilitator (Boese et al., 2013). On the other hand, from the viewpoint of the students, it would be ideal if they have a chance to test their learned knowledge and skills in a new scenario or in real life as their postactivities (see Kolb, 1984; Merrill, 2002).

However, as the pedagogical model is flexible in nature, all of the phases mentioned above *(preactivities, introduction, simulator and scenario briefing, scenarios, debriefing* and *postactivities*) are not necessarily found in all simulation-based courses, or there may be additional phases as well (*theory input*). Some of the phases may also be less important, for instance, if the participants are already familiar with the environment. Dieckmann (2009b) notes that there is often more than one simulation scenario and debriefing in each simulation-based course, which means that some of the phases may occur only once, while the scenarios and debriefings occur more often. Therefore, there are usually some participants who are not taking part in a particular scenario but are watching it via television in a separate room. However, they can still participate in the debriefing. The characteristics of meaningful learning can also be emphasized differently, depending on the learning objectives and the participants. As noted, the model can be applied and modified for a specific context and group of participants.

Overall, the pedagogical model can be used to make informed choices with regard to simulation-based education, but it can also be used to identify areas of knowledge and skills that need to be developed. In other words, the pedagogical model ensures that a more holistic and meaningful approach to teaching and learning is adopted. With the help of the model, facilitators and students will recognise their responsibilities as facilitators and learners and understand that the instruction is informed by current learning theories. During the research process for this dissertation, the pedagogical model was designed for educators who utilize or will utilize SBLEs in their teaching to give some new ideas and insights into instruction. However, the model can be shared with students and designers of environments as well. The model will make students aware of the pedagogical basis of the instruction, which will help them prepare for the forthcoming learning experience (e.g., Fanning & Gaba, 2007). Designers can also consult the model when designing new learning environments.

9 GENERAL DISCUSSION *and* CONCLUDING REMARKS – TOWARDS MEANINGFUL SIMULATION-BASED PEDAGOGY

This last chapter discusses the main findings of this study and evaluates them and the research at a general level. It also provides information about how the ethical guidelines of research were followed. Finally, it provides some practical and theoretical implications generated by the study, as well as looking towards the future of simulation pedagogy.

9.1 Summary of the Research Results

The general objective of the present study has been to understand teaching and learning in SBLEs and see what kind of theoretical underpinnings such processes need in order to aid meaningful learning by students. A more specific aim has been to design a pedagogical model for healthcare facilitators for using SBLEs in a pedagogically appropriate way. The designed pedagogical model is based on learning theories, the characteristics of meaningful learning, and previously developed pedagogical models, as well as the studies undertaken as part of this research. In the beginning of the research journey I set the following research question, which I aimed to answer in the course of this study:

What kind of pedagogical model supports facilitating and students' meaningful learning in SBLEs?

The designing process involved collecting large amounts of data and listening to the viewpoints of different kinds of participants. Overall, the study is based on facilitators' (n = 21) and students' (n = 136) viewpoints of the teaching and learning processes in SBLEs. In the first Sub-study, I had discussions with eight facilitators about their approaches to teaching and learning in SBLEs as well as the educational tools they used. During Sub-study II my aim was to understand the students' (n = 97) expectations of the learning process in these environments. In Sub-study III, I followed the enthusiasm sparked by Sub-study I and explored the conceptions of teaching and learning of healthcare facilitators (n = 13) and students (n = 30) further. In Sub-study IV the first pedagogical model design was assessed on the basis of the evaluation of the simulation-based courses from the viewpoint of the characteristics of meaningful learning. The redesigned pedagogical model is presented in this dissertation.

The main outcome of this study is the pedagogical model to be used by healthcare educational practitioners. The characteristics of meaningful learning are one core theoretical component of this model. Based on the prior studies undertaken as part of this dissertation, as well as prior studies on meaningful learning, fourteen characteristics were chosen to describe, foster and evaluate students' meaningful learning as well as aid facilitators in their tasks. These characteristics also help in concretizing the socio-cultural theory of learning (Palincsar, 1998) by translating socio-cultural perspectives into more concrete principles (Karagiorgi & Symeou, 2005). Within the pedagogical model for simulation-based learning, the real-time learning process is scripted into *Introduction*, *Simulator and Scenario Briefing*, *Scenarios* and *Debriefing* phases. This classification is not new (Joyce et al., 2002; Dieckmann, 2009b), but in the pedagogical model those phases are completed with the characteristics of meaningful learning, and especially with those characteristics that were not fully realized in previous research (Sub-studies IV) but need more emphasis (Issenberg et al., 2005). In addition, the pedagogical model sheds light on the pre- and postactivities of the facilitator and students that are highly relevant for students' learning and for the development of simulation-based education.

In addition to the concrete outcome of this study, which is the pedagogical model, the study has broadened our understanding of the current pedagogical uses of SBLEs. In particular, it has produced knowledge about the conceptions of teaching and learning held by healthcare students and facilitators (Sub-studies I and III). It has also pinpointed the expertise required of facilitators in these novel learning environments (Sub-study I and II). Furthermore, it sheds light on healthcare students' expectations of the learning process in SBLEs (Sub-study II) as well as on the characteristics of meaningful learning that are beneficial in simulation-based learning (Sub-studies IV). To my knowledge, many of these topics had not been studied previously. To summarize the main results of the research project:

- teaching approaches may vary, but in SBLEs the most essential thing is the facilitation of students' learning (Sub-studies I-IV),
- teaching in SBLEs as a way of communicating knowledge and skills to students was more popular among the facilitators than among the students (Sub-study III),
- SBLEs require well-prepared and knowledgeable facilitators (Sub-studies I and II),

- learning is a multifaceted phenomenon, but is seen here mostly as an active and student-centered process (Sub-studies I-IV),
- we should be attentive to differing views about teaching and learning (Sub-study I and III),
- students, especially adult learners, have high expectations of activities involving SBLEs (Sub-study II),
- small groups are more suitable for simulation-based learning than large ones (Sub-study I),
- learning within SBLEs can be considered to be inherently meaningful (Sub-study IV),
- students' individuality and expectations of learning through SBLEs need to be addressed (Sub-studies I–IV),
- setting general learning objectives as well as individual learning goals is important (Sub-studies II and IV),
- evaluating and reflecting on the learning goals of the course, as well as on the students' individual learning goals, are a crucial part of the learning process (Sub-study IV).

In summary, simulations can take many forms and can be considered as a set of techniques and technologies from verbal role-playing to advanced virtual worlds. However, it is not only necessary to develop these novel learning environments, but also the pedagogy and theories behind them (e.g., Entwistle & Peterson, 2004; Helle & Säljö, 2012; Kneebone, 2003). Essentially, this study has gathered information about teaching and learning in SBLEs from multiple perspectives, and has tried to figure out how we can enhance learning in SBLEs by using the pedagogical model.

9.2 Overall Evaluation and Methodological Considerations of the Study

The present study enhances our understanding of simulation-based education from healthcare facilitators' and students' perspectives. It has produced a pedagogical model that can be used to foster students' meaningful learning in SBLEs. The pedagogical model that I have introduced here is the result of previous studies and the two case studies and DBR cycle. However, it was not truly designed together with practitioners or put into practice in the simulation settings, so there are clearly shortcomings in our application of the DBR approach. In all cases we as researchers were hoping to follow the DBR approach, but the schedules of the facilitators and students were so tight that we had to give up the co-designing sessions and implementation of the model in practice. Consequently, the collection of data can be best described as case studies, both of which have yielded refinements in the model. As noted, in this study I have developed the pedagogical model iteratively, as suggested by the DBR approach (see also Keskitalo et al., 2010; Keskitalo & Ruokamo, 2011), whereas the Sub-studies have produced useful knowledge for the development of the model (cf. Laru, 2012; Muukkonen-van der Meer, 2011). Testing of the model adequately during the teaching experiments would have required the facilitators to modify courses that were part of the established curriculums, so it would have required too much extra work on their part. Thus, we decided to evaluate the courses based on our model and gave suggestions for further development of the model and practice. However, in both case studies, almost all of the facilitators were familiar with the model since it was presented to them before the courses, but it should be borne in mind that practical testing of the pedagogical model is still incomplete and further research is needed.

Although the overall design process lacked a joint designing event, multiple viewpoints were taken into account as the research progressed. This is clearly one strength of this study. Following the second case study, the model was discussed and critically reflected on together with three simulation educators, two educational scientists and a service designer. In this discussion we were able to validate the model and refine it even further. Furthermore, there seems to be some controversy about simulation-based healthcare education, and the research project has given me an opportunity to collaborate with enthusiastic facilitators who welcomed us to observe and study their daily practices. I can firmly state that the pedagogical model takes into account the views of the facilitators and students with whom we worked and to whom we listened closely during this study. How these views can be put into practice and how well they work remains to be seen.

The present study took advantage of various types of triangulation: theoretical, methodological, data and researcher (Denzin, 1978). This is one of the study's strongest features. The selection of theories and methods was based on the various aims of the studies, as well as on how to improve the overall validity of the study (Denzin, 1978; Gray, 2004; Säljö, 2009). Most of the sub-studies were qualitative, although through the use of questionnaires I was able to reach quite a large number of students when enquiring about their expectations concerning learning in SBLEs (Sub-study II). A large number of studies in the field of simulation-based healthcare education are quantitative, aiming to measure how much participants have learned, but I think we also need qualitative research to capture the viewpoints of participants in order to form a complete picture of the phenomenon (Cohen et al., 2011; Cook et al., 2011). Collins et al. (2004) remark that the success or failure of any given innovation cannot be evaluated in terms of how much the participants have learned; instead we must use multiple measures in order to see if the innovation in question really works.

In using DBR and case study approaches, methodological triangulation and the inclusion of many participants in this study have yielded quite a large volume of data. During the case studies I collected various kinds of qualitative data (interviews, group interviews, video recordings, field notes, learning diaries, open-answer questionnaires) which have helped me understand the present phenomenon comprehensively. However, some of these methods can be considered as self-reporting, which although commonly used in educational research, may not always be the best choice (Kember, 1997). With these methods there is a danger of misinterpretation, especially when interviewing subjects in a language in which one is not totally fluent. Our presence in the courses could also have influenced the participants' performance and, therefore, should be kept in mind.

As I mentioned, some of the data remain unanalyzed, which is typical for the DBR method (Wang & Hannafin, 2005). It has been my choice to leave some of the data unanalyzed and pick the most appropriate data for each study. As Gray (2004) states, the data collection and analysis should be focused in some way, especially when a case study approach is applied. In this study, it was mainly the theoretical framework and research questions that guided me to choose the data used in answering particular questions. However, it should be kept in mind that with different choices the results might have looked slightly different.

In analyzing the data, I have utilized both quantitative and qualitative methods. In sub-study II, the data were analyzed using quantitative methods (factor analysis and reliability analysis). The Cronbach's alpha for the study's subscales was acceptable in each case, which indicated that these variables could be used to describe students' expectations (Nunnally, 1978). Although the gender distribution was uneven, it was a normal distribution for healthcare education in Finland (Saarenmaa et al., 2010). Because of this, I did not attempt to figure out differences in expectations between the genders.

The present study's qualitative data have been analyzed using a qualitative content analysis method (e.g., Graneheim & Lundman). By enhancing the reliability of the studies I have tried to describe the data collection and process of analysis in detail. The presence of another researcher in the collection and analysis of the data (Sub-studies III-IV) has also helped me strengthen the overall validity of the study (Denzin, 1978), since we were able to discuss and come to conclusions together. Moreover, the video recordings and field notes were helpful in verifying the analyses made on the basis of the textual data (Sub-studies IV). During Sub-study I, the participants also had a chance to comment on my interpretations, which enhances the reliability of the results.

One limitation of this study is that there is some variation in terminology between the different sub-studies (Sub-studies I-IV). This can be explained by the quite long research period involved (2007–2015) and because my own learning has progressed during this time. Moreover, there is some disagreement about how different types of simulation technologies should be labeled (Alinier, 2007), and this has sometimes caused some confusion within my own thoughts. For example, from 2008–2009 when the data were collected in the ENVI virtual center, ENVI was a new kind of environment (see Chapter 6), so defining it clearly so that everybody would understand it in the same way was difficult. Towards the end of the study and my learning process, I have started to view it simply as a simulation center (the official name is ENVI Virtual Centre of Wellness Campus™) that houses many different kinds of simulation technologies, including a 3D incident environment with special effects, which is a feature that makes it unique compared to other simulation-based learning environments.

The present study was conducted during different research projects and involved various partners. On one hand, this has been a strength, because the projects offered valuable opportunities for the researchers, but it has also been a weakness, since the research partners were selected beforehand. So my position has been that of a project researcher whose work has been framed to some extent by the university, the project partners and the financiers.

Despite the limitations of the present study, it has broadened our understanding of simulation-based learning and, most importantly, produced a pedagogical model to help practitioners. As a researcher, I have been able to objectively observe the practice and make interpretations based on my educational background while being attentive to the viewpoints of the participants. The evaluation of this dissertation is not the only occasion when this study has been examined and assessed. The sub-studies have been evaluated many times and constructive feedback has been provided by anonymous reviewers of the journals to which I have submitted the articles, and by teachers and supervisors of the doctoral school[2] with which I have been involved, conference committees and participants, other PhD students, as well as other researchers from my research community. All of these people and their contributions have influenced the overall quality of the study.

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2. Doctoral Programme for Multidisciplinary Research on Learning Environments

9.3 Ethical Considerations

Ethical considerations are important whenever human subjects are involved in research (Cohen et al., 2011; National Advisory Board on Research Ethics, 2009). In this study, research ethics were considered in every case, since for every sub-study (I-IV) research permission was applied for and, in most cases, approved by the local institutional review board (Sub-studies II-IV).

In the beginning of each sub-study, the participants were informed about the purpose of the study and the activities that would be conducted during the studies. In each study, it was guaranteed that participation was voluntary and the participants could refuse or withdraw from the study at any time. These aforementioned actions concern the ethical principles of *autonomy* and *self-determination*. In addition, the participants were informed that they would not receive any compensation for taking part in this study, but instead that the study was an important part of the development of the pedagogical model and educational practice. This relates to the *costs/benefits* dilemma which is often present in social science research (Cohen et al., 2011) and is linked to the principle of *avoiding damage* to the participant (National Advisory Board on Research Ethics, 2009). The studies conducted during this research process were conducted mostly as part of courses integrated into the curriculum. Studies I and II were conducted using interviews and questionnaires. In these studies, the data collection was conducted at the participants' work or study place, so to make participation as easy as possible. The aim was to keep additional work for the participants to a minimum. However, it was stated that this study would eventually lead to developments in practice from which the participants could benefit.

In the present study, consent forms were obtained from each participant. The forms included information about the purpose of the study, data collection methods, and the planned uses of the data, as well as a declaration that no participant's identity would be exposed in any phase of the research. It was estimated how long each data collection would take. The researcher's contact information was provided in case someone might have further enquiries. Each participant provided an individual statement saying whether he or she allowed, for example, video recordings to be shown in research conferences. The participants' privacy was further guaranteed by saving the data in a locked closet, where it could be accessed only by the researcher. The data obtained from Stanford were also transported in a locked briefcase. These actions thus clearly fulfill the ethical principles of *privacy* and *confidentiality*.

9.4 Implications and Future Directions

The present study has produced a pedagogical model for SBLEs which is a combination of various theoretical perspectives. First of all, the model suggests that we should consider learning in a wider socio-cultural context (Säljö, 2004; 2009; Palincsar, 1998; Vygotsky, 1978) in order to understand the complexity of learning and development of expertise. Secondly, the pedagogical model is comprised of the characteristics of meaningful learning which provide a theoretical foundation for facilitators' pedagogical thinking and their approaches to teaching. Although learning within SBLEs can be considered to be quite meaningful, there are still characteristics that we can support even more. For example, the goal-oriented characteristic was not fully realized (Sub-study IV), but is often considered to be very important for simulation-based education (Alinier, 2011; Dieckmann, 2009b; Fanning & Gaba, 2007). Therefore, it is not enough simply to state the learning objectives before the learning process begins, but special emphasis should be given to them before, during and after the learning process. Learning objectives can also be emphasized in other ways than abstract statements of objectives: for example, by showing a video of desired behavior (Merrill, 2002), which can be especially suitable for simulation-based learning. As Gibbons et al. (1980) have stated, self-directed learning may in the long run be even more important to the development of expertise than formal education, where the formal articulation and evaluation of goals is the focal activity.

This study has several implications for the development of the characteristics of meaningful learning. In order to find those that are most appropriate for enhancing students' learning and their meaningful learning experience, we need more research. To enhance learning we should find the most critical features that affect the learning experience, improve the outcome and eventually improve healthcare practice. Therefore, more research is needed to find *the meaningful characteristics of simulation-based learning*. In addition, the meaningful learning characteristics could all be elaborated in more detail. What does the implementation of, e.g., socio-constructive characteristics mean in the present context when utilizing these particular simulation technologies, and having these particular students, learning goals and scenarios? To summarize, more research is needed to find out exactly how simulation-based learning stimulates students towards meaningful learning. In addition, it would be interesting to find out if facilitators emphasize and prefer different characteristics than students.

The pedagogical model contains six phases (*Preactivities, Introduction, Simulator and Scenario briefing, Scenarios*, *Debriefing and Postactivities*) that can be followed. However, I think every phase of these simulation-based training phases is worthy of a more detailed look. Interesting questions in future studies could be whether participants are learning in other phases than debriefing (e.g., Fanning & Gaba, 2007) and what they are learning in these phases (Säljö, 2005). Dieckmann et al. (2012) have stated that the success of debriefing depends on the whole simulation experience. Therefore, it would be interesting to find out what can be done in the introduction in order to accomplish the introductory part successfully in order to enhance the students' learning. Moreover, we can find out whether students are learning something in this phase and, if so, identify what they are learning. As noted, theoretical triangulation can provide a fuller and deeper understanding of learning (Denzin, 1978), but I think there is also a danger that we remain at too shallow a level (cf. Säljö, 2009). Therefore, future studies should concentrate on the model at an even more detailed level.

As noted, the pedagogical model reminds facilitators of their important tasks before, during and after the simulation activity, since accentuating students' activity and self-directedness does not mean releasing the facilitators from their important tasks. Instead, simulation-based education seems to demand plenty of work and conscientiousness from the facilitators (e.g. Alinier, 2011; Keskitalo, 2012) as well as enthusiasm for developing one's own expertise (Keskitalo, 2011). Thus, there is a need for proper instructor training. For students' learning, the pre- and postactivities are also essential (Brewer, 2011).

The teacher's main role as the facilitator of students' learning in this particular learning environment was emphasized in Sub-studies I-IV. Consequently, learning was seen mostly as an active, student-centered process (Sub-studies I-IV). However, there were differing views about teaching and learning among healthcare facilitators and students (Keskitalo et al., 2013), which could negatively affect the instructional process and eventually the students' outcomes (Entwistle et al., 2000; Trigwell, 2012). In practice, this could be solved by being as informative as possible, even before the course starts when the descriptions and goals for the courses are stated (Zigmont et al., 2011a). For example, information could be provided about what, if anything, should be read beforehand, what the students are about to learn and why, and what the model of instruction and assessment will be, among other questions. This way, learners would know better what to expect, and what is expected of them. Facilitators should also ensure that their instruction is in line with the stated expectations and ground rules of the course (Biggs, 1996; Laurillard, 2012). However, the sub-studies that investigate facilitators' and students' conceptions were quite descriptive; therefore, in future studies, it would be interesting to quantify results in order to see what conceptions are more common within simulation-based healthcare education and which are related to successful study and good clinical performance.

In the first sub-study, the facilitators mentioned that having fewer students in simulation sessions would be more beneficial for learning. This was stated from a Finnish perspective; however, this study shows that the situation is different in the US, where educating students and professionals seems to take different forms. So, this study has implications for the Finnish context of education: How can we educate approximately 15 students effectively in SBLEs? How can we keep other students active while some are taking part in the scenario? This relates to the individual characteristics of meaningful learning that were addressed in every sub-study (I-IV) from both facilitators' and students' viewpoints. In these highly collaborative settings, facilitators need creativity and sensitivity in order to figure out how to take students' individuality into account and address it during the learning process. It takes time to get to know the students (their characteristics, level of competency, needs, etc.) as well as to provide individual feedback or organize counseling sessions. Furthermore, students would need to have the courage to approach facilitators if they think they would benefit from more individualized feedback. As noted, it is also important to create an emotionally safe environment early on, because this affects not only the whole simulation exercise and how it eventually goes (Dieckmann & Yliniemi, 2012; Zigmont et al., 2011b), but also the overall learning process.

A key result of this study was the creation of the pedagogical model, which still warrants further research in addition to the aforementioned viewpoints. In order to develop an effective and user-friendly pedagogical model, we have to conduct more iteration where practitioners are involved from the beginning and the model is really put into practice in order to test its value and the shape of the theory and practice (Barab, 2006). In other words, we should organize teaching experiments. This would mean that the current model would be introduced to facilitators and explanations of how it could be used would be given in a detailed way. The facilitators themselves could then think of how the model could be applied in practice and what modifications they would make in their courses. Thereafter, the facilitators would run the simulation-based courses and we would observe and collect various kinds of data. After the co-designing session and data analysis, we would be closer to the desired pedagogical model. Eventually, we would be able to know what kinds of pedagogical models and methods would enhance meaningful learning and expertise in students. It would also be interesting to compare different pedagogical models in order to see which ones lead to meaningful learning in students and eventually to improved performance.

To facilitate further activities and research, the confusion in terminology in this field should be resolved (Alinier, 2007). In order to do this I suggest that we map the existing terms used and examine how they are used and in which contexts. On the other hand, we could apply the Delphi technique to get expert opinions concerning the most appropriate terms in the field of simulation-based healthcare education (De Villiers, De Villiers & Kent, 2005). Then we would be able to identify the most appropriate terms to use in the field. In this research I have used the term "simulation-based learning environment" to refer to technologically rich learning environments where the aim is to educate healthcare practitioners and students with different types of simulation technology, which most often includes the use of patient simulators.

However, this is not the only type of simulation. For example, beginning students usually have facilitator-led basic skills or protocol practice (see Figure 4).

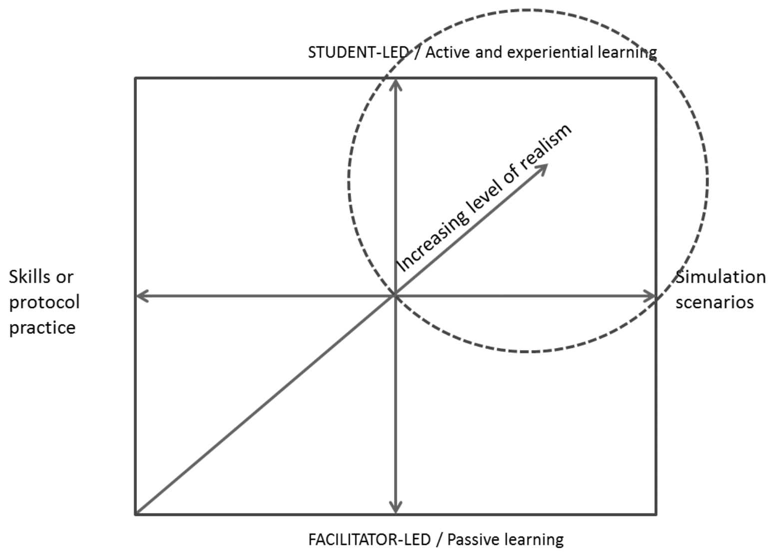

Figure 4. Focus of this research and direction for future research (adopted from Alinier, 2011).

As Figure 4 shows, I have concentrated on one area of simulation-based learning (see the circled area), although many other forms also exist (Gaba, 2004). In this study I have concentrated on teaching and learning in simulation-based learning environments where the learners actively treat patient simulators during the simulation scenarios. In the future, interesting questions to study could be, for example, how to establish skills stations or in-situ simulations and how much facilitator support would be needed in them, and what kind of script would be beneficial in these types of learning. In other words, what would the pedagogical models in these other types of simulation-based education be? The simulation-based learning activities were all rather similar in this study. Furthermore, I think the field of SBLE-based learning would benefit from an educational research review the aim of which would be to map and synthesize educational theories that have been used to inform simulation-based education. Now, the knowledge is somewhat fragmented into different sources, and it is difficult to form a coherent picture of what we already know and what questions remain unanswered.

The present research also has implications for practicing research. In this study I tried to follow the principles of the DBR method. However, the research context made this virtually impossible, since the participants had many obligations and thus had limited time and availability. For instance, we did not have enough time to familiarize the facilitators with how to use the pedagogical model. Likewise, co-creation and joint planning of the pedagogical model was missing, something that I think is essential for the development of the field (cf. Silvennoinen, 2014). In the future, participants should allot time for this kind of development work, or else the learning experience will be incomplete. As noted, in the future, we need to refine the design of the experiments in order to accomplish our tasks more successfully.

9.5 Conclusion

The present study explored simulation-based learning in the field of healthcare. Its particular interest was to develop a theoretically and empirically justified pedagogical model for simulation-based learning environments to be used by healthcare educational practitioners. For this purpose, multiple research questions were set and a variety of theoretical and methodological perspectives were taken into account. It was also important to consider both the healthcare facilitators' (n = 21) and students' (n = 136) views in the course of this study.

In particular, this study shed light on the pedagogical use of simulation-based learning environments in healthcare, which has previously been a rather technologically and content-driven arena. However, it is universally recognized that no technology teaches on its own, but educational theories and pedagogically grounded instructional design are necessary to support the technology (Helle & Säljö, 2012). Although this study did not attempt to form a coherent theory of simulation-based learning, it did take a step towards creating a more coherent understanding of simulation-based learning by providing an educational perspective on the issue. According to Säljö (2009, p. 202), we need "richer frames of references from which to analyse learning". In addition, this study examined issues that had not previously been investigated within this context, namely conceptions of teaching and learning, students' expectations, and meaningful learning.

This study also helped us to answer the questions of how SBLEs should be applied in pedagogically appropriate ways in the form of a pedagogical model. According to Ausubel, Novak and Hanesian (1978, p. 6):

> It is true that some traditional "rules of teaching" have withstood the test of time and are probably valid. Nevertheless, their application varies as educational conditions and objectives change, and thus not even the most vener-

> able rules can be followed blindly. Rules must always be reexamined in the light of changing conditions. Further, since by definition rules are stated in general terms, there cannot be a rule for each situation a teacher is likely to encounter. Principles are more flexible than rules, because, being less prescriptive, they can be adapted to individual differences between persons and situations. In addition, most educational situations require balancing of several pertinent principles rather than the arbitrary application of a single rule.

As noted, it is more useful to design flexible principles than rules which can be followed in one situation, but may not work in another one. This study resulted in some general principles that can be valuable for simulation educators, practitioners, designers and researchers. However, these principles do not provide an exact recipe for how the learning environment and the learning process should be designed. Instead, the pedagogical model is a general framework that directs our actions and may raise new ideas and thoughts about simulation-based pedagogy (Bransford et al., 1999).

Although the present study still lacks some evidence and more research is needed, through this research project I have emphasized some features that may lead to even more meaningful learning. In the future, we should take the shortcomings of this study into account and investigate this highly topical issue and almost untraveled path in an even more carefully planned manner. Eventually we will be wiser in answering the questions of when and how to use these technologies (Cook et al., 2011), and according to Dolmans et al. (2005), the design-based research approach can help us achieve this task. Meanwhile, this study has brought to the forefront some theoretical perspectives and issues that are valuable for the further development of simulation pedagogy, which can help to make simulation-based healthcare education desirable and meaningful for participants, and eventually help in improving healthcare practice.

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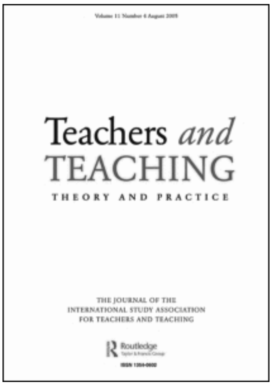

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Teachers' conceptions and their approaches to teaching in virtual reality and simulation-based learning environments

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Teachers' conceptions and their approaches to teaching in virtual reality and simulation-based learning environments

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This research article focuses on virtual reality (VR) and simulation-based training, with a special focus on the pedagogical use of the Virtual Centre of Wellness Campus known as ENVI (Rovaniemi, Finland). In order to clearly understand how teachers perceive teaching and learning in such environments, this research examines the concepts of teaching and learning, pedagogical models and methods as well as the educational tools used by ENVI teachers ($n = 8$). Data were collected through thematic interviews and analysed using the content analysis method. This interview study indicates that teachers saw ENVI's use in education as indisputably beneficial, because it has brought authenticity to teaching and provided students with experiential learning opportunities. ENVI has also made possible the integration of theoretical and practical knowledge. Teachers had widely accepted their role as facilitators of student learning but held widely varied conceptions of learning. Teachers' underlying conceptions become evident in their student-centred approach to teaching and in their utilisation of problem-based learning. However, their use of pedagogical models was not consistent or well defined which has been the case in previous research. Although teachers still need education and support to use a variety of pedagogical models, the results of this study suggest that teachers are moving in the direction of adopting student-centred approaches. So far, this research has offered a starting point for developing a pedagogical model for VR and simulation-based learning environments. As well, it offers useful insights regarding teaching, especially for healthcare teachers, teacher educators, instructor trainers, designers and researchers.

Keywords: healthcare education; teachers; conceptions; pedagogical models and methods; VR and simulation-based learning environments; thematic interview

Introduction

The sparseness of population in a northern country like Finland, combined with its arctic climate, results in unique proficiency requirements for healthcare, acute care and rescue personnel. In response to these needs, the Virtual Centre of Wellness Campus (ENVI) was set up at Rovaniemi, Finland. ENVI creates life-like rescue, first aid and emergency care situations using advanced technology. ENVI, as it was implemented at the Lapland Vocational College and the Rovaniemi University of Applied Sciences in Finland in the years 2005–2008 and today with its cardiac care unit, bed and surgical wards as well as child health clinic and distance consultation room (see

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www.envi.fi), is specifically designed for personnel and students in the field of healthcare to develop, test and maintain their know-how and knowledge. In short, ENVI could be viewed as a simulation centre (Lane, Slavin, & Ziv, 2001) or, in more detail, an integrated procedure virtual reality (VR) simulator (cf. Gaba, 2004; Kneebone, 2003) wherein healthcare personnel and students can experience a safe and realistic learning environment to repeatedly rehearse the practical work of healthcare.

Feedback from users of ENVI has been very positive, although the new environment has also brought challenges for it users. This is the case also in many other simulation centres. Initially, the focus was on building environments, but now the emphasis has shifted towards the use of simulations (Kneebone, 2003). This article will focus on VR and simulation-based training, with a special focus on the pedagogical use of ENVI.

This research is the first phase of a design-based research (DBR) project (Brown, 1992; Design-Based Research Collective, 2003). The overall aim of the DBR is to develop a pedagogical model for organising teaching and learning processes in ENVI and other simulation centres. In pursuit of this goal, we follow on Joyce and Weil's (1980) definition of a teaching model as 'a plan or pattern that can be used to shape curriculums (long-term courses of studies), to design instructional materials, and to guide instruction in the classroom and other settings' (p. 1). Overall, then, we understand pedagogical models as tools used in designing, implementing and evaluating education. The advantage of pedagogical models lies on their ability to provide theoretical backgrounds for teaching as well as tools to plan teaching in advance (Tissari, Vahtivuori-Hänninen, Vaattovaara, Ruokamo, & Tella, 2005).

Compared to available research about university teachers' conceptions of teaching and learning, as well as their approaches to teaching (e.g. Bruce & Gerber, 1995; Kember & Kwan, 2000; Postareff & Lindblom-Ylänne, 2008; Postareff, Lindblom-Ylänne, & Nevgi, 2007; Tissari et al., 2005; Trigwell & Prosser, 1996), there is only sparse information on healthcare teachers' conceptions of teaching and learning and their approaches to teaching in VR and simulation-based environments. Indeed, it is important to make explicit those underlying conceptions and theories, because teachers' approaches to teaching and learning outcomes are influenced by teachers' conceptions of teaching and learning (Campbell et al., 2001; Entwistle, Skinner, Entwistle, & Orr, 2000; Lonka, Joram, & Bryson, 1996). In this task, pedagogical models may help teachers to recognise those underlying theories and to select the best possible pedagogical approach as the background for their teaching. To that end, this study is designed to elicit those concepts of teaching and learning, pedagogical models and methods, as well as educational tools used by teachers in ENVI.

Although, the use of simulations in education has proven to be effective, Issenberg, McGaghie, Petrusa, Gordon, and Scalese (2005) suggest that more emphasis should be put on their pedagogical use. According to Kneebone (2003), the use of simulation should be underpinned with appropriate pedagogical theories to avoid the domination of technology within the field. In this article, the results from data collected from interviews with eight of the nine ENVI teachers in February 2008 about the use of VR's and simulations are presented (see also Keskitalo, 2008). The data were analysed using the content analysis method (Brenner, Brown, & Canter, 1985). From this data, knowledge about teachers' pedagogical use of ENVI is received and this data could provide point of departure for designing a pedagogical model for VR and simulation-based learning environments (Keskitalo & Ruokamo, in press; Keskitalo, Ruokamo, & Väisänen, 2010).

What follows is a brief introduction to the research on simulations and the use of VR in professional education as it related to the design of ENVI. Then, the data collection and analysis methods used in this study are described. Following these, the results of our inquiry are presented and discussed.

Background research on the use of simulations and VR in ENVI

Technological advances have made it possible to create simulations that fully engage learners in the environment and the learning process. In the field of healthcare, these can vary from a simulated operating theatre with a sophisticated high-fidelity human patient simulator to humans who act as simulated patients (Rosen, 2008). In particular, the utilisation of VRs in healthcare education is increasing (Kneebone, 2003; Rosen, 2008).

Gaba (2004, pp. 3–6) has provided a comprehensive framework for understanding the diversity of applications of simulation in healthcare using 11 different dimensions; each dimension represents a different characteristic of simulation. The dimensions are as follows: (1) the purpose and aims of the simulation activity; (2) the unit of participation in the simulation; (3) the experience level of simulation participants; (4) the healthcare domain in which the simulation is applied; (5) the healthcare discipline of personnel participating in the simulation; (6) the type of knowledge, skill, attitudes or behaviours addressed in simulation; (7) the age of the patient being simulated; (8) the technology applicable or required for simulations; (9) the site of simulation participation; (10) the extent of direct participation in simulation; and finally (11) the feedback method accompanying simulation.

ENVI – Virtual Centre of Wellness Campus

Following Gaba's (2004) framework for understanding simulations (see Figure 1), we see the purpose of the ENVI design to be that students learn to manage the tasks and skills needed in the field of healthcare. The unit of participation is usually a team because students work as healthcare professionals and members of a team. The aim of their active participation and interaction in the environment could be skills training, exchange of knowledge and experiences, problem-solving and clinical reasoning, or performance assessment (see also Lane et al., 2001). The third and fourth dimensions

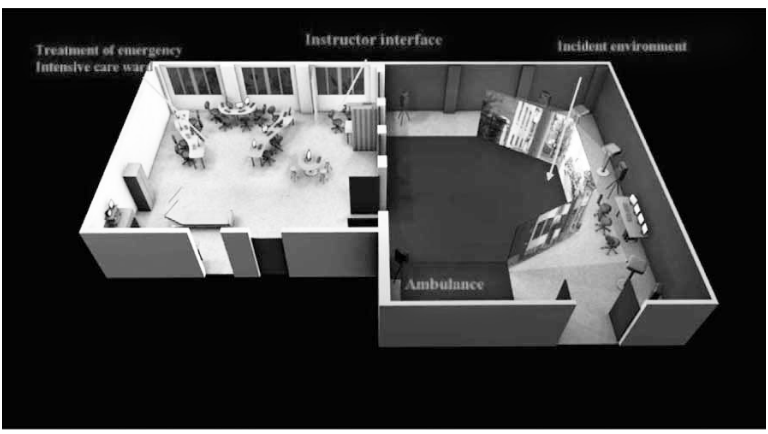

Figure 1. ENVI – Virtual Centre of Wellness Campus. (Reprinted with permission from Lapland Vocational College and the Rovaniemi University of Applied Sciences© 2009.)

(experience and domain) consider the experience level of simulation participants and the area of healthcare in which the simulation is applied. In this case, ENVI provides a rehearsal for students and personnel in the field of healthcare, especially in acute care and rescue, to develop, test and maintain their know-how and knowledge. In the future, ENVI may also be utilised in engineering and business economics education, for example, testing the usability of clinical equipment in the environment. According to Gaba's fifth dimension (discipline), ENVI is applicable to all disciplines of healthcare, including physicians, nurses, paramedics, technicians and many others.

Gaba (2004) categorises simulations according to the type of knowledge, skill, attitudes or behaviour addressed therein. In ENVI, students can be taught new knowledge and skills, as well as how to combine theory with practice so as to be able to transfer learned skills into actual situations and to be able practise skills that are not performed very often. With reference to age and to applicable or required technology (Gaba's seventh and eighth characteristics), ENVI contains three different kinds of patient simulators: one baby and two adult patients. In the field of healthcare, simulators are devices that involve simulation of a patient or various parts of a patient (Rall & Dieckmann, 2005) – all available to help students learn a wide range of skills without risk to a real patient. The ENVI environment also contains three three-dimensional incident environments (home, traffic and ski-slope) complete with special effects and a hand-held interaction device. This is the feature that makes it unique from other simulation centres. Gaba refers to this kind of simulator as a VR simulator.

Other technologies at ENVI include an ambulance as well as treatment in an emergency and intensive care ward, video and audio recording devices, and all the equipment needed at the incident environment, in an ambulance, and in the initial phase of hospital care, as well as special programmes for handling patient data. An additional feature is a working space for the teachers. In ENVI, learners can go through the whole multidisciplinary care process and take the patient from the accident scene to the hospital for further treatment. Kneebone (2003) uses the term 'integrated procedure simulator' to refer to these simulators that make it possible to practise the whole healthcare process. Therefore, ENVI could be viewed simply as a simulation centre (Lane et al., 2001) or, in more detail, as an integrated procedure VR simulator (cf. Gaba, 2004; Kneebone, 2003).

The extent of direct participation in simulation and the feedback method accompanying simulation are the two final dimensions of Gaba's (2004) framework. Not only is it possible for healthcare professionals at ENVI to practise with and within the simulation, there also could be a group watching the simulation training of their peers. According to Gaba, the feedback method is used to maximise learning, and can also be understood as a critical feature of simulation-based education (see also Issenberg et al., 2005). In ENVI, the instructor, other students and the simulator itself are the major sources of feedback. Feedback involves reflection on emotions, actions, thoughts and interaction (Fanning & Gaba, 2007; Issenberg et al., 2005). In ENVI, the video and audio recording devices can be used in debriefing sessions to complement feedback and to enable thoughtful examination of one's practice.

Teachers' conceptions, approaches to teaching and pedagogical models in VR and simulation-based learning environments

In this study, conceptions of teaching and learning mean teachers' assumptions and beliefs about them. Prior research has indicated that teachers' approaches to teaching are influenced by their conceptions of teaching and learning (Postareff et al., 2007; Trigwell & Prosser, 1996), which derive from their experiences with, and theoretical knowledge of subject matter and pedagogy (Tynjälä, 2006). Studies of teachers' conceptions of teaching have identified two broad categories: 'teaching as transmission of knowledge' and 'teaching as learning facilitation'. Teachers as knowledge transmitters is a typical conception of teachers who have adopted a teacher-centred approach to teaching, and teachers as facilitators of students' learning is a typical conception of teachers who have adopted a student-centred approach to teaching (Kember & Kwan, 2000). The teacher-centred approach views students as passive recipients of information (e.g. Kember & Kwan, 2000; Postareff & Lindblom-Ylänne, 2008; Trigwell & Prosser, 1996), whereas a student-centred approach views learning as an active construction of knowledge by students. Earlier studies have also shown that if teachers adopt a teacher-centred approach to teaching, students are likely to adopt a surface approach to learning; that is, memorising facts or remembering the course's content (Entwistle et al., 2000; Marton, 1975). On the other hand, if teachers adopt a student-centred approach to teaching, students are likely to aspire to a deeper understanding of knowledge. Student-centrality, then, is usually associated with constructivist theories (Duffy & Jonassen, 1992; Tynjälä, 1999).

In addition to these two broad conceptions of teaching, prior studies have defined several related concepts of learning (e.g. Bruce & Gerber, 1995; Lonka et al., 1996; Säljö, 1979). For example, Bruce and Gerber (1995) have identified six different categories:(1) acquiring knowledge through the use of study skills in the preparation of assessment tasks; (2) the absorption of new knowledge and being able to explain and apply it; (3) the development of thinking skills and the ability to reason; (4) developing the competencies of beginning professionals; (5) changing personal attitudes, beliefs or behaviour in response to different phenomena; and (6) learning as a participative pedagogic experience.

Bruce and Gerber's (1995) research suggests that when teachers focus beyond the individual student using a broad learner-centred pedagogy, both teachers and students come to see learning as a social phenomenon in the ways described by Lave and Wenger (1991) and, earlier, by Vygotsky (1978) whose socio-cultural theory posits learning as influenced by social, cultural and historical factors, as well as being tool-dependent. This view of learning is especially important in simulation settings, where students interact and construct knowledge with each other and with teachers, in an environment, and interact with various technical devices (Dieckmann, Gaba, & Rall, 2007). In actual teaching practice, this means that teachers focus both on individuals and on the social community and that the educational tools used are recognised as having a critical influence on the way students learn and think.

Current understandings of learning have also been profoundly influenced by Vygotsky's (1978) identification of the 'zone of proximal development' (ZPD), i.e., the area between a learner's current developmental level and the level that the learner can reach with assistance of an adult or a capable peer (p. 84). Bruner (1975) proposes the concept of scaffolding to describe the type of assistance provided in students' ZPD by teachers and capable peers. As the scaffolds fade slowly into the background, learners become independent and more able to manage tasks on their own. Kneebone, Scott, Darzi, and Horrocks (2004) find both the ZPD and scaffolding useful conceptual frameworks for teaching clinical skills in VR and simulation-based contexts.

In medical and healthcare education, the traditional approach to teaching and learning has been the learning-by-doing approach – an underlying principle of the apprenticeship model which has long been used to teach basic principles and skills to novice learners (Kneebone, 2003; Kneebone et al., 2004). In the traditional apprenticeship model, the apprentice views the master executing tasks, and then the apprentice tries to execute the tasks with the master's guidance and help (Rogoff, 1990). However, with the current emphasis on patient safety, teachers have largely abandoned having students practising with real patients (Kneebone, 2003).

Another pedagogical model that has long been used in medical and healthcare education is problem-based learning (PBL) (e.g. Barrows & Tamblyn, 1980). The PBL approach views learning as a problem-solving process that starts by dealing with authentic problems that originate in practitioners' working lives. During the PBL process, students work in groups, but they also engage in self-directed learning; teachers in the PBL model work mostly as tutors or facilitators supporting students' learning (Hmelo-Silver, 2004). Despite PBL's widespread use, evidence of its superiority over other methods remains inconsistent (Hmelo-Silver, Duncan, & Chinn, 2007; Issenberg et al., 2005; Kirschner, Sweller, & Clark, 2006). The reason for this could be that several PBL models can address real-life problems (cf. Boud & Feletti, 1999), and depending on the situation, as Tissari et al. (2005) found, teachers can use pedagogical models in different ways.

In recent years, simulators and simulations have been introduced to healthcare education because of their ability to provide students with experiential learning opportunities and a safe environment for repeated practice (Cleave-Hogg & Morgan, 2002). In the simulation setting, courses can be structured according to the *Learning through Simulation Model*, which includes an orientation, participant training, participation in the simulation and debriefing (Joyce, Calhoun, & Hopkins, 2002; cf. *introduction*, *simulator briefing*, *scenarios* and *debriefing*, Dieckmann et al., 2007). In the introductory phase, a teacher presents the course's topic and most important concepts, and explains the simulation concept to the students. This phase also should include an explanation of how the course is organised and what kinds of pedagogical models and methods it uses. During participant training or the simulator briefing, participants begin to get into the simulation. This is the phase when the teacher introduces the scenario. As a learning trigger a teacher might use a problem or real-world example. Phase 2 includes an introduction of the simulation's goals, the participants' roles, rules, procedures and the decisions they have to be able to make during the scenario. At the end of the second phase, teachers should ensure that everybody has understood the instructions. In Phase 3, students participate in the simulation. During this phase students are active, while teachers function as facilitators or instructors giving feedback, correcting misunderstandings and evaluating students' performance and decisions. However, comprehensive evaluation and reflection take place during the debriefing phase, when the teacher should encourage students to analyse the whole process, how the scenario went, what problems they encountered and what they learned. In this phase, it is also important to compare the simulation to the real world.

According to the research literature and learning theories, some premises are suggested for organising teaching in simulation settings. For example, teachers should adopt a student-centred approach to learning because it promotes deeper understanding of knowledge (Entwistle et al., 2000) and, consequently, teachers should take the role of facilitators (Hmelo-Silver, 2004; Kember & Kwan, 2000; Kneebone et al., 2004). In addition, teachers should provide tasks that are in students' ZPD – not too easy, but manageable for students if there is appropriate support (Vygotsky, 1978). In order to provide experiential learning opportunities for students, teachers should create scenarios that are based on real-world examples or problems (Jonassen, 1995; Kneebone, Nestel, Vincent, & Darzi, 2007; Kolb, 1984) and, to maximise learning, extensive orientation, feedback and reflection must support the practice (Dieckmann et al., 2007; Fanning & Gaba, 2007; Issenberg et al., 2005; Joyce et al., 2002; Kneebone et al., 2004).

As noted, with the help of different kinds of pedagogical models, teachers have many options for teaching in VR and simulation-based environments. Previous research has indicated that teachers use pedagogical models in three different ways: teachers plan teaching based on one model, combine different models or choose particular features of various models (Tissari et al., 2005). Pedagogical models also help teachers and students to evaluate teaching and learning (Tissari et al., 2005). Especially in PBL and the *Learning through Simulation Model*, evaluation and reflection play an important part in the teaching and learning process (Hmelo-Silver, 2004; Joyce et al., 2002).

Research question and methods

This research is the first phase of the DBR method, the aim of which is to develop a pedagogical model for organising VR and simulation-based learning. The DBR involves continuous cycles of design, enactment, analysis and redesign (Brown, 1992; Collins, Joseph, & Bielaczyc, 2004; Design-Based Research Collective, 2003). The research question guiding this phase of the larger study is: ‘What kinds of concepts of teaching and learning, pedagogical models and methods, and educational tools are teachers using in VR and simulation-based learning environments?’ The goal was to find out what kinds of pedagogical approaches and educational tools teachers have adopted when teaching their subject matter in ENVI.

It was hypothesised that teachers use pedagogical models and methods, as well as educational tools, as educational resources. The interview data collected could provide knowledge about teachers’ pedagogical use of ENVI, which could serve as a point of departure for designing a pedagogical model for VR and simulation-based learning environments. Here, teachers are defined as all those who are teaching or have taught in ENVI – a group comprising teachers from the Rovaniemi University of Applied Sciences and Lapland Vocational College, as well as trainees (later referred to also as teachers). At the time of the interviews, only nine teachers actually had taught in ENVI; therefore, the target group was small (eight of the nine). The teachers’ field of teaching was most often nursing or emergency care. Their work experience in the field averaged 18 years. Their teaching experience varied from temporary posts to 16 years, but most often their teaching experience was from one to three years. The teachers had received considerable pedagogical training; most had attended pedagogical courses, but some had taken pedagogical training (60 ECTS, European Credit Transfer System). In Finland, pedagogical training is compulsory for teachers in the Universities of Applied Sciences. In addition, the teachers have received short courses about the pedagogical use of information and communication technologies.

The data were collected in February 2008 using thematic interviews, each of which lasted from 40 to 80 minutes. This method was chosen because it is designed, using free and open-ended discussion, to provide insight into what participants (here, teachers) know and think (see e.g. Cohen, Manion, & Morrison, 2000) regarding the research question. The themes built into our interviews included background information; the possibilities and limitations of ENVI’s educational use; the basis of the teacher’s pedagogical thinking; the pedagogical principles, models and methods used in ENVI; the teacher's role; the pedagogical community's strength; the need for education and the teacher's participation in developmental work. The interviewees were asked questions such as: Does the technology and ENVI bring some additional value for teaching and learning? Are there any limitations in the use of ENVI? How do you think people learn? Do you use any kind of pedagogical principles or models when you plan your teaching? What kind of a role do you have as a teacher in ENVI? Do you receive support from your colleagues? Have you participated in development work in your field? Teachers were encouraged to give examples, for example, to describe how they use pedagogical models and methods in their teaching.

Analysis began with a research assistant transcribing the interviews' audio data word by word; then, the author analysed them for themes. Analysis was performed using the content analysis method (Brenner et al., 1985; Graneheim & Lundman, 2004). The following phases constituted the analysis: (1) reading the research data; (2) reading the research data once again and coding the data with paper and pencil with respect to the research question of this study; (3) making short summaries of each transcription's essentials and then developing a mind map based on the readings and initial coding; (4) coding the data for the second time and creating tentative categories; and (5) specifying the tentative categories and creating final themes based on the research question and coding process (see Table 1).

Based on the coding process and research questions the themes are as follows: teachers' varying conceptions of teaching and learning; utilisation of various pedagogical models and methods when planning, executing and evaluating teaching and learning in ENVI; and educational tools as well as benefits and challenges brought by ENVI. Finally, the interview data were interpreted within the theoretical background presented earlier. Excerpts from the data are presented below to describe the theory and the interpretations based on the data. To ensure the trustworthiness of the study, the participants were offered the possibility of reading and commenting on the research results and interpretation made from the interviews (Graneheim & Lundman, 2004). As a result of the feedback, the article was changed a little, but the actual interpretation was not questioned.

Findings

Teachers' varying conceptions of teaching and learning

The concepts of teaching and learning that teachers choose derive from their experiences with and theoretical knowledge of the subject matter and the pedagogy that they have attained in the course of their formal education (Tynjälä, 2006). In this research, the question concerning concepts of learning prompted many thoughts among the interviewees. This finding may be explained by the fact that a person rarely reflects on his own concept of learning – a phenomenon which suggests that becoming aware of it and expressing it can be difficult. In this research, several teachers emphasised that human beings learn by doing and exploring. As noted earlier, this is a widely accepted view in medical education (Kneebone, 2003; Kneebone et al., 2004). This concept seems to parallel another concept that Lonka et al. (1996) call 'active epistemology'. Within this concept, students are perceived as active and intentional individuals in the learning process: Teacher 1 described, 'Or is it exploratory learning, or what, but the learners do not accept having knowledge "poured into" them; they want to try by themselves'. Teacher 4 emphasises the importance of learning-by-doing and application of knowledge (cf. Bruce & Gerber, 1995), 'However, I think that in nursing, nobody

Table 1. Research questions, categories and themes used in this study.

Research questions and categories	Themes
What kinds of concepts of teaching and learning had the teachers adopted?	Teachers' varying conceptions of teaching and learning
Teachers' conceptions of teaching:	
(1) Teacher as expert on the subject matter	
(2) Teachers as facilitators of learning	
Teachers' conceptions of learning:	
(1) Learning by acquiring knowledge	
(2) Learning by doing and exploring	
(3) Learning as individually different process	
(4) Learning as a process where students construct their own view of the phenomena	
What pedagogical models and methods do teachers use when planning, executing and evaluating teaching and learning in ENVI?	Utilisation of various pedagogical models and methods when planning, executing and evaluating teaching and learning in ENVI
(1) Students and course content as a starting point for learning	
(2) Utilisation of the principles of problem-based learning when planning and executing teaching	
(3) Utilisation of learning through simulation model when structuring the course	
(4) Varying pedagogical methods	
(5) Varying evaluation methods and emphasis on debriefing	
What kinds of educational tools are teachers using and what are the benefits and challenges brought by ENVI?	Educational tools as well as benefits and challenges brought by ENVI
Educational tools:	
(1) Utilisation of varying education tools	
Benefits and challenges brought by ENVI:	
(1) ENVI has brought authenticity to teaching	
(2) ENVI has enabled the integration of theory into practise	
(3) Teaching in ENVI requires strong expertise in the subject matter, teachers' own effort as well as the right attitude	
(4) Teaching in ENVI requires small student groups	

learns by just reading theories, but, like, by making and doing things in those situations, and then kind of being able to link the theory to practice'.

Some of the teachers mentioned that they rely on the constructivist concept of learning. Echoing constructivist theories (Duffy & Jonassen, 1992; Lonka et al., 1996; Tynjälä, 1999), these teachers emphasised the learners' active involvement in the learning process, especially in knowledge construction and in increasing their understanding of the subject matter, as Teacher 5 described:

> Well, if one thinks that I have this kind of long work experience, so I think I rely on this kind of constructivist concept; one adds new knowledge to old knowledge and expertise is developed through one's own thinking and a kind of reflection.

Consequently, it seems that the teachers saw their own role as more of a facilitator of learning than a knowledge transmitter, although they also viewed themselves as experts in the subject matter. As Teacher 6 explained, they are 'experts, who lecture there as expert or present some topic as well as they are a kind of tutor, who guides the learning'. Also important in the learning process was the integration of theoretical and practical knowledge. When building connections between theory and practice, the teachers used real-world examples, which, in this environment, were usually called 'problems' or 'stimuli'. According to Bruce and Gerber (1995), this type of activity is typical for teachers, who see learning as developing the competencies of beginning professionals (cf. Laksov, Lonka, & Josephson, 2008). When asked about learning, the teachers also emphasised students' individuality. They viewed students as individuals with their own individual characteristics.

All in all, teachers in this research perceived teaching mostly as facilitation of students' learning, and, in learning, students' own activity was seen as the most important factor. Overall, they viewed learning as a process, in which students actively construct their own knowledge and adopt their own way of practising the skills needed in their future careers: '… constitute your own view of what you see, hear and experience, and then you build your own knowledge based on your previous knowledge … differently observing, sensing you build the knowledge' (Teacher 6).

Utilisation of various pedagogical models and methods when planning, executing and evaluating teaching and learning in ENVI

Conceptions of teaching and learning influence what kind of teaching approaches teachers adopt. The pedagogical model that was most frequently applied and mentioned when planning and executing teaching in ENVI was PBL. Teachers appear to take the students' characteristics and the course content into account. Yet, the teachers' descriptions of how they used PBL were inconsistent and not well defined (cf. Issenberg et al., 2005; Tissari et al., 2005), as Teacher 1 described:

> Well, in principle, I do not know what to talk about. Whether we talk about PBL thinking or competencies or what. Yes, the pedagogical starting point has all the time been problem-based in a way. We start with some problem.

The reason for this could be that there are several PBL models each addressing real-life problems (cf. Boud & Feletti, 1999), and depending on the situation, as Tissari et al. (2005) found, teachers often use these pedagogical models in different ways.

The teachers' description of their realisation of a course in simulation settings resembled the *Learning through Simulations Model* (Joyce et al., 2002), as can been seen from following description:

> I think what learning results they need to accomplish, I think those also together with students … and then we define those together and then we think those methods, which are then practised, and then we go through the learning stimulus and then students practise according to that and how they can. Then, we go through those experiences. And we think that what else we need to learn; are there any gaps? (Teacher 6)

In the introductory phase teachers usually went through the learning goals, introduced the environment and the equipment as well as the problem students needed to solve. In this phase, some teachers also utilised assignments given in advance. They used these to orient and motivate students for the upcoming learning situation and to arouse their prior knowledge. The teachers also considered simulator briefing and debriefing as highly important phases of simulation-based training. However, they also saw debriefing as challenging, because the accomplishment of deep dialogue is not obvious (cf. Fanning & Gaba, 2007). At best, according to these teachers, debriefing could lead to new learning goals and developmental needs. During scenarios, they mentioned flexibility as one of the core ideas that also features in the student-centred approach to teaching (cf. Postareff & Lindblom-Ylänne, 2008). According to these teachers, there should be space for changes because in real practice, patient care is not straightforward, as Teacher 1 stated:

> I think that, that [course structure] can not be so precisely thought in advance, that it goes according to this plan … Because it is not straightforward that patient care and kind of that situation, it does not necessarily go according to plan in real-life either. (Teacher 1)

Although their descriptions of approaches to teaching were still student-centred (cf. McLeod et al., 2006), many of these teachers did not cite any particular or conscious pedagogical model as a basis for their teaching. In most cases, their course's structure was similar to the *Learning through Simulation Model*. They planned their teaching according to the student group and their teaching objectives, for example, the competencies set for nurses or the content of the study module (cf. Bruce & Gerber, 1995). They claimed that one reason they do not use pedagogical models was a lack of pedagogical education:

> Perhaps I do not have much of a consciously chosen pedagogical model at this point, because I haven't finished my pedagogical studies yet, but maybe it [teaching] is based on those competencies in a way; from the beginning one tries to teach what they [students] will need to know after the three years. (Teacher 7)

In this study, only some of the teachers used PBL when evaluating teaching and learning. As Teacher 5 stated, 'Well, now we think about evaluation in a sense, that also this process, this learning process, has been evaluated quite a lot, and I have tried to take that into account … In PBL evaluation is continuous'. Despite the fact that teachers do not emphasise the use of PBL in evaluation, they claimed to value the role of debriefing which they view as the most critical feature of simulation-based training (cf. Fanning & Gaba, 2007; Issenberg et al., 2005), as Teacher 8 confirms: '… and then this debriefing, analysing and watching the videos, that's how it went, so I adhere to those'. In addition to video playback and discussions, evaluation and reflection methods include written and oral feedback as well as traditional tests.

In this research, teachers adopted a variety of pedagogical methods in education. This enabled them to take into account students' individual learning styles in order to enhance their learning, as Teacher 4 did: '… learning occurs differently … so I have always tried to illustrate and highlight theoretical knowledge in many ways …' Pedagogical methods that teachers mentioned in this research include, for instance, lessons, self-directed learning, group work, questioning strategies and role-play. For example, Teacher 3 described, 'I use a lot of discussions, I like a blackboard and a flip board and drawing and asking questions, involvement … I am very delighted to take advantage of varied things'.

Educational tools as well as benefits and challenges brought by ENVI

All teachers who were using ENVI referred to it as the educational tool they used most. But they also used traditional educational tools, for example, written materials, overhead projectors, *PowerPoint* slides and network-based learning environments (NBLEs), such as Moodle, LearnLinc and Optima. They used NBLEs to deliver assignments and other course materials to students. According to the teachers, ENVI's benefits are indisputable. All teachers mentioned that the environment has brought authenticity to teaching. As Teacher 2 described: '… it sort of puts meat around the bones in what has previously been discussed in the classroom that, thinking back to the 1980s, well, you know, we didn't have the same possibilities'. The teacher meant that nowadays students can learn in experiential environment and practise with real equipment before they encounter actual cases, whereas before students were taught in classrooms where they needed to rely on their imagination. In addition, some teachers mentioned that in ENVI, students can experience the same feelings as in real working situations as well as practise in a safe environment where they are allowed to make mistakes. Most of the teachers also mentioned that ENVI is well suited to teaching the subject matter. ENVI has enabled the integration of theory into practice – acknowledged often to be a problem within medical education and in higher education (Laksov et al., 2008; Tynjälä, 1999). As one of the teachers, Teacher 3, stated, 'The theory comes alive. That they [students] saw, what it means that patient has cardiac failure'. The teachers saw ENVI as an empowering learning tool that has given them new and diverse possibilities for teaching; however, its full potential remains untapped (cf. Rall & Dieckmann, 2005):

> If one thinks, for example, nursing education involves such practical manual skills, then of course there is the theory of diseases, confronting the patient, the feelings of the nurse in the situation … confronting the relatives and, perhaps, confronting different cultures. All kinds of things. And medical treatment. (Teacher 4)

> … how it could be exploited by the other students also. Perhaps by organising and planning teaching events so the students from social sciences could also participate in the practice, in what is going on here. You could always think of some educational field and how they can come and practise here together. (Teacher 2)

For teachers, ENVI has also brought many challenges. Teacher 7 described the challenges as follows: 'You need to be expert. You need to know what are you talking about … And you have to know how you use the environment and those equipment'.

Teacher 1 specified that mastering the health and welfare technology in ENVI is especially important for teachers:

> And that environment and mastery of the equipment do not mean something technical – whether you can set up some environment or set up something now; mastery is specifically related to the equipment and the things we use in patient care. (Teacher 1)

Also, teachers' own fears may become obstacles for teaching in ENVI. According to teachers, teaching in VR and simulation-based learning environments requires open-mindedness as well as teachers' own effort and desire to develop. As Teacher 6 described, 'If you stick to the old routines, basic teaching, and then, however, it does not fit there completely, but you need to start from more open, that the learning needs draw from students …' These teachers saw pedagogical planning for using ENVI as important because it helps to actualise the teaching and learning processes smoothly. However, ENVI has also brought about a situation that they could not have planned in advance; therefore, they stressed flexibility. The biggest problem the teachers noted is too large a group of students. The ideal group size, they suggested, is small, for example, four students in each session. If the groups include more students than this, they suggested that two teachers should be present in each session.

Discussion and concluding remarks

As previous studies have indicated, healthcare education should not remain opinion-based and intuition-based (Ramani, 2006) or unconscious (McLeod et al., 2006). As Kneebone (2003) has stated, more emphasis should be put on the pedagogical use of VRs and simulations. Therefore, this study attempts to make explicit the teaching practices used in VR and simulation-based environments for teachers, teacher educators, instructor trainers, designers and researchers. The eight teachers and trainees who participated in this study expressed their views and ideas concerning the underlying theories of learning, pedagogical models and methods, and educational tools used in ENVI. This study is the first phase of the DBR and, partly on this ground, the overall aim is to develop a pedagogical model for organising teaching and learning processes in ENVI and other simulation centres.

Results of this study indicate that the teachers saw teaching mostly as facilitation of students' learning (Kember & Kwan, 2000), whereas views of learning were more varied. According to the teachers, students learned partly by acquiring knowledge (Säljö, 1979), by doing and exploring, and by constructing for themselves, the knowledge and skills needed in their future careers (Bruce & Gerber, 1995; Lonka et al., 1996; Säljö, 1979). According to teachers, learning was also seen as an individually different process. These conceptions may have arisen because ENVI as a learning environment encourages students' own activity and in that environment, the traditional type of teaching is almost impossible. ENVI's novelty may also be the reason why teachers felt that they needed more education in development of their pedagogical know-how.

Teachers' underlying conceptions became evident in their student-centred approach to teaching and in their utilisation of PBL. However, their use of pedagogical models was inconsistent and somewhat eclectic, which also was the case in previous research (Tissari et al., 2005). The teachers also emphasised students' individuality, which made them choose various methods for their teaching. The results also showed that the participants saw ENVI's use in education as indisputably beneficial, because it brought authenticity to teaching and provided students with experiential learning opportunities (cf. Cleave-Hogg & Morgan, 2002). In addition, ENVI seems to have significantly improved the integration of theoretical and practical knowledge that has long been lacking in higher education (Laksov et al., 2008; Tynjälä, 1999). However, teaching in ENVI also requires effort from teachers, including familiarisation with the environment, especially with the health and welfare technology, strong expertise in the subject, planning and flexibility.

Given these results, this study has its limits. First, caution should be taken when drawing conclusions from the research results because of the small number of participants, although almost all (one teacher refused to take part) of the teachers included in the research had been trained in ENVI. In the future, if there were more teachers, it would also be interesting to find out whether teaching in this new kind of environment generates different conceptions of teaching and learning than previous studies have defined. For example, teachers in this study did not emphasise learning as a social phenomenon (Lave & Wenger, 1991; Vygotsky, 1978; Wells & Claxton, 2002), which, however, is important to consider in VR and simulation-based learning environments. Secondly, little can be said from these results about how teachers perform in actual situations. Are they executing student-centred approaches to teaching, or is there inconsistency between their words and the actual situations? Therefore, a study will be conducted from the students' perspectives in order to discover if teachers are truly student-centred in their teaching. Thirdly, it is possible that teachers interpreted the questions differently and therefore provided answers to different questions. However, it should be noted that the interest was in teachers' personal beliefs, theories and approaches. Because teachers' personal views were the main interest, the thematic interview was also considered to be a useful approach (see e.g. Cohen et al., 2000). Fourthly, one drawback of this research is that pilot interviews were not carried out before the actual interviews; these would have helped to refine the interviews. As noted, this study was exploratory in nature; thus, in future studies, as our DBR proceed, multiple data collection methods and a greater number of participants will be adopted in order to generate more sweeping research results than this study provided. For example, the observations will be conducted in this particular environment in order to clearly understand the nature of teaching and learning in these environments.

This study's results suggest that the ENVI teachers are moving towards adopting student-centred approaches to teaching. However, since currently these teachers' use of pedagogical models is somewhat eclectic, and they appear to choose features from different models or no model at all (cf. Tissari et al., 2005), it seems necessary to develop a pedagogical model that is suited for teaching in VR and simulation-based learning environments as such. They, themselves, claimed that the development of pedagogical know-how was a principal need.

Drawing on the work of Postareff et al. (2007) and that of Bruce and Gerber (1995), both of whom claim that pedagogical training is crucial in improving and changing teaching practice, we suggest that teachers who are just starting education in simulation settings need appropriate education for the use of technology so as to help them to overcome their fears related to the technology that ENVI contains as well as adequate technical support while teaching.

The study's data provide knowledge about teachers' approaches to teaching in ENVI. Hence, it provides a point of departure for designing a pedagogical model.

Designing a pedagogical model is based on the DBR method (Brown, 1992; Design-Based Research Collective, 2003).

The next phase of our inquiry is designed to collect data about students' expectations of teaching and learning processes in VR and simulation-based environments. The core issue in this developmental process is to address theoretical questions about the nature of learning in the novel context of simulation and VR as well as define useful educational principles that can be employed to plan, implement and evaluate education in these contexts (Collins et al., 2004). After careful design and testing phases, an effective pedagogical model should emerge. Such a model could serve to make teachers aware of the different choices and means available to them and help them design, implement and evaluate VR and simulation-based education.

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Students' expectations of the learning process in virtual reality and simulation-based learning environments

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Expectations for simulations in healthcare education are high; however, little is known about healthcare students' expectations of the learning process in virtual reality (VR) and simulation-based learning environments (SBLEs). This research aims to describe first-year healthcare students' (N=97) expectations regarding teaching, studying, and learning in such environments. In addition, it measures students' expectations of instructors, their academic self-perception, and atmosphere, as well as whether there are differences between the expectations of adult and young students. Data was collected through a questionnaire from two different universities of applied sciences in Finland in spring 2009, and analysed using statistical and qualitative methods. Overall, students have quite high expectations of the activities that take place in VR and SBLEs. Adult learners in particular seem to have high expectations compared to younger students.

Introduction

Healthcare educators have long used simulations to enhance patient safety. These simulations vary from a simulated operating theatre with a sophisticated, high-fidelity human patient simulator, to a human who acts as a simulated patient (Bradley, 2006). These days, advances in technology have made it possible to create simulations that fully engage learners in the environment and the learning process (Bradley, 2006; Cobb & Fraser, 2005). Thus, the utilisation of virtual realities (VRs) in healthcare education is also growing rapidly (Kneebone, 2003; Rosen, 2008).

In recent years, interest has grown in examining students' expectations and perceptions of the educational environment in medical schools since learning environments are in many ways related to students' behaviour, academic achievements, satisfaction, and aspiration (Miles & Leinster, 2007). However, research related to expectations about the learning process in VR and simulation-based learning environments (SBLEs) remains absent. Expectations for simulations are high in healthcare education; their use is expected to improve patient care and enhance patient safety. In healthcare education, simulations are expected to improve learning and provide students with experiential learning opportunities (Cleave-Hogg & Morgan, 2002; Gaba, 2004; Loke, Blyth & Swan, 2012; Rall & Dieckmann, 2005). Simulations potentially provide a safe and realistic learning environment in which repeated practice is possible. Additionally, some expect simulations to enable the integration of theory into practice (Issenberg, McGaghie, Petrusa, Gordon & Scalese, 2005; Rall & Dieckmann, 2005).

This research aims to describe healthcare students' (N=97) expectations regarding teaching, studying, and learning in VR and SBLEs prior to experiencing them. It also examines the kind of expectations students have of their instructors, atmosphere, and themselves as learners. Here, studying and learning are used separately because the purpose is to emphasise students' active role in the learning process. That is, teaching does not always lead to learning; rather students' own activities are also necessary (Kansanen et al., 2000; Uljens, 1997). The data was collected from two different universities of applied sciences in Finland in spring 2009, using mixed methods. The questionnaires' open answers were analysed qualitatively and used to support the quantitative analysis. This article is part of a larger study whose overall aim is to develop a pedagogical model for VR and SBLEs using design-based research methods (Brown, 1992; Design-based Research Collective, 2003; see also Keskitalo, Ruokamo & Väisänen, 2010). The first phase consisted of thematic interviews with teachers. The goal was to determine the kinds of pedagogical approaches and educational tools teachers have adopted when teaching in VR and SBLE (Keskitalo, 2011). In this second phase, the aim is to learn about students' expectations of the learning process in VR and SBLEs (see also Keskitalo, 2009). This should enable the design of a user-friendly pedagogical model and ensure its integration into healthcare education practice.

The overall aim of this research is to change pedagogical practices in VR and SBLEs by embedding learning theoretical views into teaching practice, because previous research has shown that healthcare education remains somewhat intuition and opinion-based (Ramani, 2006). In other words, teachers are using their opinions or intuition to determine their pedagogical methods. What follows is an introduction to the literature, research questions, and methods. The last section presents and discusses the research results.

Literature review

Previous studies of students' expectations

In this study, the term "expectations" refers to students' expectations regarding the learning process in VR and SBLEs. Many definitions are used to describe expectations within the service delivery sectors (Higgs, Polonsky & Hollick, 2005; Shewchuk et al., 2007). Expectations could be expected or predictive, which, in this study, could be students' predictions of or beliefs about teaching and studying in VR and SBLEs. In other words, what will occur in these learning environments? Normative expectations are expectations about what should occur in VR and SBLEs (Higgs et al., 2005; Shewchuk et al., 2007). There are also experience-based expectations, which are expectations that follow prior experience, in this case, healthcare education or practice (Parasuraman, Zeithaml & Berry, 1988).

In medical and healthcare education, the existing research literature related to students' expectations of teaching and learning in VR and SBLEs is limited. So far, the research that has been done relates to medical students' perceptions of their educational environment (Amin, Tani, Eng, Samarasekara & Huak, 2009; Miles & Leinster, 2007) and their expectations for their future medical practice (Draper & Louw, 2007; O'Connell & Gupta, 2006). One study tried to develop a standardised approach to assessing physicians' expectations and perceptions about continuing medical education (Shewchuk et al., 2007). Miles and Leinster (2007) studied first-year medical students' expectations about the learning environment and compared those results to the students' actual perceptions. Their results revealed that students initially encounter their learning environment with high expectations, although they do not expect the learning environment to be perfect. Overall, students' expectations for learning and teachers, and their academic self-perception and social self-perception were higher than their actual perceptions. In particular, the study found that teachers were worse at providing feedback than students expected and did not provide the constructive criticism that students expected. The learning objectives were also unclear to students, the school schedule was not scheduled as well as they expected, and the support system for stressed students was poorer than they had expected. In their study, Miles and Leinster (2007) used the revised *Dundee Ready Education Environment Measure* (DREEM) (Roff et al., 1997) to measure medical students' expectations about their educational environment.

In Draper and Louw's (2007) study, most medical students found the curriculum's content contrary to their expectations. They expected their medical degree to be mostly biomedical and scientific in content, and did not expect the curriculum's psychosocial component to be a feature of studying medicine. These students viewed the medical profession as significant and influential. Also, O'Connell and Gupta (2006) found that despite the challenges of practising medicine, students have realistic perceptions of the current medical practice environment.

Teaching and learning in virtual reality and simulation-based learning environments

The apprenticeship model has long been used in medical and healthcare education to teach basic principles and skills to novice learners (Kneebone, 2003; Kneebone, Scott, Darzi & Horrocks, 2004). In the traditional apprenticeship model, an apprentice views the master executing a task, and then the apprentice tries to execute the task with the master's guidance and help (Rogoff, 1990). The main problem with this model has been the issue of patient safety because students were practising with real patients. Nowadays, problem-based learning (PBL) has become a popular approach to teaching in medical and healthcare education (e.g., Barrows & Tamblyn, 1980). PBL sees learning as a problem-solving process in which students deal with authentic and ill-structured problems that originate in real-life work. During the learning process, teachers work mostly as tutors or facilitators and support students' learning, whereas students work in groups and engage in self-directed learning (Hmelo-Silver, 2004; Hmelo-Silver & Barrows, 2006). These approaches are based mainly upon experiential learning approaches (Hmelo-Silver, 2004), for example, Kolb's (1984) experiential learning model that views learning as a continuous process grounded in experience. In addition, PBL utilises the ideas of social-constructivism and socio-cultural theory (Lave & Wenger, 1991; Tynjälä, 1999; Vygotsky, 1978).

Simulators and simulations have been introduced to healthcare education because of their ability to provide students with experiential learning opportunities and a safe practice environment (Cleave-Hogg & Morgan, 2002). In simulation settings, a typical course structure consists of an introduction, simulator briefing, scenarios, debriefing, and course ending (Dieckmann, Gaba & Rall, 2007; Joyce, Calhoun & Hopkins, 2002). According to Joyce and associates' (2002) *Learning through simulations model*, in the introductory phase, the teacher presents the course topic and the most important concepts, and explains the simulation concept to students. This phase also includes explanations of how the course is organised, and the kinds of pedagogical models and methods it uses. During the simulator briefing, the participants begin to get into the simulation. This is the phase in which the teacher introduces the scenario. As a learning trigger, the teacher uses either problems or real-world examples. The second phase includes the introduction of the simulation's goals, the participants' roles, the rules and procedures they have to follow, and the decisions they have to be able to make during the scenario. At the end of the second phase, the teacher ensures that everybody has understood the instructions. In phase three, students participate in the simulation. During this phase, students are active while the teacher functions as a facilitator or instructor by giving feedback, correcting misunderstandings, and evaluating students' performance and decisions. However, comprehensive evaluations and reflections occur during the debriefing phase when the teacher encourages students to analyse the whole process, including how the scenario went, what problems they encountered, and what they learned. In this phase, it is important for students to compare the simulation to the real world.

Research questions

With these theories and the cited literature as background, this study focuses on students' expectations related to teaching, studying, and learning processes in VR and SBLEs. The following research questions were set:

- What kinds of expectations do students have about teaching, studying, learning, and instructors in VR and simulation-based learning environments?
- What kinds of expectations do students have of their academic self-perception and atmosphere in VR and simulation-based learning environments?
- Are there differences between the expectations of adults and those of young students?

Methods

Data collection

This research collected data using a questionnaire given to the students (N=97). This questionnaire was partially based on the DREEM (Roff et al., 1997) as well as other questionnaires that have been developed to measure meaningful learning (Nevgi & Löfström, 2005; Hakkarainen, 2007). The original DREEM was a 50-statement questionnaire which was developed to measure the educational environment of health professions. DREEM's statements were divided into five subscales, namely students` perception of teaching, teachers, academic self-perception, atmosphere, and social self-perception. However, for the purpose of this research, some questions from the original DREEM were eliminated and questions regarding the expectations of studying and learning were added, since the original DREEM examines mainly the perceptions of teaching. The additional questions were used to measure the expectations of the meaningfulness of learning (Nevgi & Löfström, 2005; Hakkarainen, 2007), which provided essential information for the design of the pedagogical model (Keskitalo et al., 2010). Some statements from the DREEM were also revised for this research, for example, "I am confident about passing this year" was changed to "I am confident about passing this course," or "The atmosphere is relaxed during the ward teaching" was changed to "During the debriefing, the atmosphere will be relaxed." The original DREEM questions that were eliminated were considered unsuitable for the purpose of this research, e.g., the questions "Cheating is a problem in this school" or "The teachers get angry in class" were considered irrelevant for our purpose. The sub-scale, "Students' social self-perception," was almost completely omitted since it was considered irrelevant. However, one statement was reworded from "There is a good support system for students who get stressed" to "Embattled students will get help," and removed to the sub-scale in our questionnaire that measures atmosphere.

Finally, to check the meaningfulness of the questionnaire, 10 students from the Rovaniemi University of Applied Sciences completed the questionnaire and gave us feedback. Thereafter, a tentative analysis and final revisions were made. These test questionnaires were not included in this research. The final questionnaire asked students for background information and questions related to their expectations of teaching, studying, and learning processes in VR and SBLEs. In addition, it measured students' expectations regarding their instructor, academic self-perception, and atmosphere. Each of the 65 statements was scored on a continuum, in which 1 = "the statement does not describe my expectations at all," 2 = "the statement describes my expectations some," 3 = "the statement describes my expectation neither poorly nor well," 4 = "the statement describes my expectations quite well," and 5 = "the statement describes my expectations well." Also, one open question gave the students opportunity to write about any other expectations they had. In this research, all the activities were conducted in Finnish, and the translations into English were made by the author and checked by a native-speaking transcription service.

The data was collected at Rovaniemi University of Applied Sciences (Rovaniemi, Finland) and Arcada University of Applied Sciences (Helsinki, Finland, http://apslc.arcada.fi/) in January and February 2009. Both schools have simulation centres consisting of separate rooms where students can practise specific skills or go through entire scenarios related to the content areas. When studying, one room is usually decorated for the students' rehearsal, and contains a patient simulator and a monitor displaying the vital signs of the patient simulator. Next to this room is a space for the facilitator, where he or she can control the simulator and guide the students' learning process via audio devices. One room is dedicated to debriefing and contains appropriate technology, such as video and audio recording devices, which can be used in debriefing sessions to complement the students' reflection. The simulation centre situated at the Rovaniemi University of Applied Sciences (known as ENVI, see http://www.envi.fi/) also includes an immersive full-scale 3-D (three-dimensional) incident environment simulation projection, in which users can view, navigate, and interact with a handheld device (for detailed description, see Keskitalo, 2011). Therefore, ENVI is kind of a mixed-reality learning environment as it combines physical environment and simulation manikins with 3-D simulation projection (see Haukkamaa, Yliräisänen-Seppänen & Timonen, 2010). The idea of ENVI is that healthcare students or professionals can practice cooperation during the entire healthcare process, from the scene of an accident, to a hospital, and finally, to rehabilitation. However, this research did not analyse the influences of the type of simulation centre; it focused instead on the students' expectations of the learning process in these environments.

The participants were first-year healthcare students who were chosen because they had little experience with training in VR and SBLEs, though they were expecting to train in this type of learning environment in the future. The purpose of choosing them on this basis was to guarantee that their experiences did not affect their expectations. The participants volunteered to take part and had an opportunity to refuse or withdraw from the study at any time. The participants received no compensation for taking part in the study.

Data analysis

The quantitative data was analysed using *SPSS 15.0 for Windows*. Altogether, 97 students volunteered to take part in the study, 82 of whom (84.5%) were female and 15 (15.5%) male. The respondents' mean age was 27 years. The youngest respondent was 19 and the oldest was 53 years old. Sixty-one of the respondents (62.9%) were nursing students. In addition, some of the students were studying paramedics (n=2; 2.1%), physiotherapy (n=17; 17.5%), occupational therapy (n=5; 5.2%), and healthcare (n=9; 9.3%). The data was analysed using factor analysis and reliability analysis (Cronbach's *alpha*). For the factor analysis, the statements were selected based on previous studies. However, as a result of the analysis, some statements that belonged to the original DREEM or the questionnaires that measured meaningful learning were discarded. Based on the results of factor analysis and reliability analysis, the sum variables were computed using a mean of the items within the sub-scale. For the analysis, the sum variable was also categorised into five categories (1 = no expectations, 2 = a little expectations, 3 = neither little nor a lot expectations, 4 = quite a lot of expectations, 5 = a lot of expectations) to get a better understanding of the level of the participants' expectations. Kolmogorov-Smirnov tests, instead of t-tests, were used to determine whether there were differences in expectations between adult and young students, because the distribution of the test variables was skewed. The individual items' means and standard deviations were also reported. The qualitative data was analysed and used to support the quantitative analysis.

Results

Students' expectations of the learning process in VR and SBLEs

The first research question was concerned with the kinds of expectations students have regarding teaching, studying, learning, and instructors in VR and SBLEs. Table 1 presents the factors and the statements with the means and standard deviations that belong to each factor (with the loadings of 0.517 to 0.890). Cronbach's *alpha* for each factor is included in the table along with the means and standard deviations of the sum variables, which are the empirical counterparts of the factors.

The results showed that Cronbach's *alpha* values were all above 0.7 (0.861 to 0.897), which indicates both an acceptable internal consistency and that the variables can be used to describe students' expectations (Nunnally, 1978). As the results indicate, students' expectations of teaching (M=3.65; SD=0.54) in VR and SBLEs were quite high; 49.5% of the respondents had quite high expectations of teaching in these environments, and 5.2% expected a lot. Most often, students expected that teaching would help to develop their competence (M=4.16; SD=0.83), would be stimulating (M=3.99; SD=0.92), and that students' needs were the starting point for teaching (M=3.86; SD=0.97). Therefore, the variable was named "*Inspiring and individually-tailored teaching*". This result was expected because many previous researchers have indicated that students enjoy simulation exercises and the opportunities provided to practise skills before encountering the real situations (Cleave-Hogg & Morgan, 2002; Holzman et al., 1995; Moule, Wilford, Sales, & Lockyer, 2008), which the following excerpts also confirm:

Table 1: Statements, Cronbach's *alpha*, means and standard deviations for each factor

Factor		Statements in the questionnaire	Cronbach's *alpha* for each factor	Means (M) and SD of the sum variable
Inspiring and individually -tailored teaching	1	I will be encouraged by the teaching (*M=3.66; SD=0.92*)	0.897	M=3.65; SD=0.54
	2	The teaching will be stimulating (*M=3.99; SD=0.92*)		
	3	Students' needs are the starting point for teaching (*M=3.86; SD=0.97*)		
	4	The teaching will help to develop my competence (*M=4.16; SD=0.83*)		
	5	The teaching will help to develop my confidence (*M=3.56; SD=1.03*)		
	6	The teaching takes students' individuality into account (*M=3.17; SD=1.02*)		
	7	The teaching encourages me to be an active learner (*M=3.67; SD=0.98*)		
Individual and compet-ence-based studying	1	In lessons, students have the opportunity to actively acquire, evaluate, and apply information (*M=3.67; SD=0.98*)	0.862	M=3.91; SD=0.64
	2	While studying in a simulation-based learning environment, I have the ability to utilise my prior knowledge (*M=4.03; SD=0.86*)		
	3	I have the opportunity to set my own goals for studying (*M=4.02; SD=0.86*)		
	4	With the instructor's guidance, I have the opportunity to practise my skills (*M=3.76; SD=1.05*)		
	5	When studying, I have the opportunity to take advantage of my prior experiences (*M=3.93; SD=0.80*)		
	6	During the course, I have the opportunity to familiarise myself and practise with the equipment I will need in my future work (*M=4.16; SD=1.13*)		
	7	During the lessons I have the possibility to repeatedly practise my skills (*M=3.66; SD=0.90*)		
	8	While studying in a simulation-based learning environment, I can feel safe (*M=3.98; SD=0.83*)		
	9	During the lessons, I have the opportunity to critically evaluate my own learning (*M=3.92; SD=0.90*)		
Transferable learning outcomes	1	I can apply the things that I have learned during the course *(M=4.23; SD=0.85)*	0.861	M=4.09; SD=0.73
	2	The things that I learn in a simulation-based learning environment help me to understand things better than I did before *(M=4.23; SD=0.80)*		
	3	I believe that using the equipment I need in my work will be easier after this course than it was before *(M=4.13; SD=0.91)*		
	4	My problem-solving skills will develop during this course *(M=3.66; SD=1.06)*		
	5	Studying in a simulation-based learning environment will develop my skills *(M=4.18; SD=0.91)*		

Competent and well-prepared instructors	1	Instructors are knowledgeable (*M=4.29; SD=0.83*)	0.878	M=3.94; SD=0.75
	2	Teachers can provide proper and constructive criticism (*M=3.69; SD=0.97*)		
	3	The teachers will have good communication skills with patients (*M=3.71; SD=0.94*)		
	4	The teachers will give clear examples (*M=4.00; SD=0.85*)		
	5	The teachers will be well prepared for teaching (*M=4.01; SD=0.94*)		

> I expect enthusiastically to get into an ENVI environment; we have not yet been in the ENVI. I expect that I will test and practise different kinds of situations and tricks. (Student, number 6)

> It is nice that we can practise in a simulated situation before being with real patients. I am sure that I am not as nervous as I would be if there was no simulated training. (Student, number 40)

Students had quite high expectations of studying (M=3.91; SD=0.64) too; 67% of the respondents expected quite a lot or a lot. As the sum variable's name ("*Individual and competence-based studying*") indicates, students particularly expected to be able to utilise their prior knowledge (M=4.03; SD=0.86) and set their own goals for studying (M=4.02; SD=0.86). Students also expected to have the opportunity to familiarise themselves and practise with the equipment they would need in their future work (M=4.16; SD=1.13), although, on this question, the standard deviation was quite high. This indicates that some of the students expected that they could familiarise themselves and practise with the equipment, but others had lower expectations in this regard. As these results indicate, students expected their studying to be constructivist and self-directed in nature. Constructivist learning means that learners build meaningful knowledge upon their previous knowledge (e.g., Jonassen, 1995; Tynjälä, 1999); self-directed learning assumes that learners can set their own goals for learning and be responsible for achieving them (e.g., Knowles, 1975).

"*Transferable learning outcomes"* was used to describe the expectations for learning (M=4.09; SD= 0.73) in these environments. Individual items indicate that most often students expected to learn things that were applicable (M=4.23; SD=0.85), and that learning in VR and SBLEs would help them to understand things (M=4.23; SD=0.80). In addition, students expected the use of equipment to be easy (M=4.13; SD=0.91) and that they would become highly skilled (M=4.18; SD=0.91) after the course. These expectations might come true; previous studies have shown that students benefit from simulation-based training. For example, in Moule and associates' (2008) study, students learned skills, but they also felt that training in a simulation-based environment increased their knowledge and understanding of the subject matter. Overall, 41.2% of the respondents expected quite a lot and 32% expected a lot from learning in these environments.

Students expected quite a lot from instructors (M=3.94; SD=0.75) as well; 33.0% of the students expected quite a lot from their instructors, and 26.8% expected a lot. Students especially expected their instructors to be competent (M=4.29; SD=0.83) and well prepared for teaching (M=4.01; SD=0.94), and to give clear examples (M=4.00; SD=0.85). Therefore, the sum variable was titled "*Competent and well-prepared instructors*." Amin et al. (2009) also found similar results when they measured the characteristics of university teachers in medical school. The characteristics that students valued most were being knowledgeable about the subject matter, being friendly and approachable, and having well-organised teaching materials.

These results place high demands on the instructors. The instructor's role in simulation-based training is quite different from that of traditional lecture-based instruction. Research has indicated that instructors need development, especially regarding different kinds of pedagogical methods (Keskitalo, 2011) and in how to facilitate debriefing (Østergaard, Østergaard & Lippert, 2004).

Students' expectations of their academic self-perception and atmosphere

The second research question concerned the kinds of expectations and perceptions students have of their academic self-perception and atmosphere in VR and SBLEs. Table 2 presents the factors and the statements with the means and standard deviations that belong to each factor (with the loadings of 0.825 to 0.835). Cronbach's *alphas* for each factor and the means and standard deviations of the sum variables are also included in the table.

Table 2: Statements, Cronbach's *alpha*, means and standard deviations for each factor

Factor		Statements in the questionnaire	Cronbach's *alpha* value for each factor	Means (M) and SD of the sum variable
Confident and competent students (academic self-perception)	1	I am confident about passing this course (M=3.73; SD=0.84)	0.835	M=3.51; SD=0.70
	2	I believe that I will be well prepared to practise my profession (M=3.46; SD=1.01)		
	3	I believe that I can manage different kinds of exercises (M=3.86; SD=0.85)		
	4	I will be able to memorise all I need from this course (M=3.12; SD=0.92)		
	5	Learning strategies that have worked for me before will continue to work for me now (M=3.41; SD=0.91)		
Relaxed and comfortable atmosphere	1	I will feel comfortable during the lessons (M=3.76; SD=0.77)	0.825	M=3.77; SD=0.64
	2	During the debriefings, the atmosphere will be relaxed (M=3.64; SD=0.77)		
	3	Embattled students will get help (M=3.70; SD=0.92)		
	4	I believe that the atmosphere will be relaxed during the lessons (M=3.99; SD=0.77)		
	5	The atmosphere will motivate me to learn (M=3.66; SD=0.95)		

The results show that students' expectations concerning their academic self-perception (M=3.51; SD=0.70) were moderately high. As the sum variable's name ("*Confident and competent students*") indicates, students were especially certain that they could manage different kinds of exercises (M=3.86; SD=0.85) and that they would pass the course (M=3.73; SD=0.84). "*Relaxed and comfortable atmosphere*" was used to describe the students' expectations of the atmosphere, which were quite high (M=3.77; SD=0.64). Individual items indicated that most often students expected that the atmosphere would be relaxed (M=3.99; SD=0.77) and comfortable (M=3.76; SD=0.77) during the lessons, and that embattled students would get help (M=3.70; SD=0.92). Although simulation exercises sometimes cause nervousness (Alinier, Hunt, Gordon &

Harwood, 2006; Cleave-Hogg & Morgan, 2002), students in this study expected the atmosphere to be relaxed during the lessons, which is a prerequisite for good learning (e.g., Cassaday, Bloomfield & Hayward, 2002). In simulation-based training, it is important that students be allowed to make mistakes without being ridiculed or humiliated. Especially in debriefing sessions, it is crucial that students are able to freely express their views and learn from their mistakes (Fanning & Gaba, 2007).

Differences in expectations between adult and young students

The third research question was: Are there differences between the expectations of adult and young students? The respondents' mean age was 27 years; the youngest respondent was 19 years old and the oldest was 53. Therefore, before the analysis, the participants were divided into two age groups based on the distribution that is popular in statistics and labour markets in Finland (Herranen & Penttinen, 2008): 1) Adult students (>25 years old; n=39; 40.2%); and 2) Young students (≤25 years old; n=58; 59.8%). To determine whether there were statistically significant differences between adult and young students' expectations, the Kolmogorov-Smirnov test was used. For analysis, the sum variables were categorised into three categories so that values 1 and 2 described little expectations, and the values four and five described great expectations. Value three was a neutral value. Percentile distributions of the adult and young students with little or a lot of expectations regarding teaching, studying, learning, instructors, their academic self-perception, and atmosphere are presented in Figure 1.

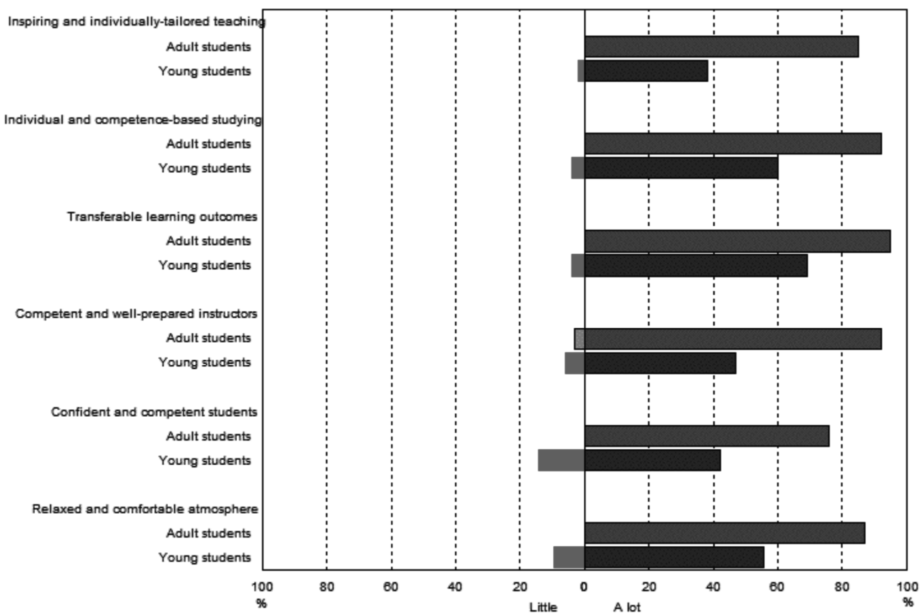

Figure 1: Percentages of adult and young students' expectations regarding teaching, studying, learning, instructor, academic self-perception, and atmosphere

As Figure 1 indicates, adult students seemed to have higher expectations than young students. The most significant differences were found in expectations regarding teaching (K-S test = .0469, p = .000, p<0.05) and instructors (K-S test = .0452, p = .000, p<0.05). However, the adult students also expected more from studying (K-S test = .0321, p = .023, p<0.05), learning (K-S test = .357, p = .008, p<0.05), their academic self-perception (K-S test = .343, p = .012, p<0.05), and atmosphere (K-S test = .314, p = .025, p<0.05). This might be because the younger students did not have as much experience as the older students. In other words, they did not have as many experience-based expectations (Parasuraman et al., 1988). Therefore, they might have been uncertain about what to expect from VR, simulation-based training, and themselves as learners, as this younger student explained:

> Because I am one of the few who have no field experience, I hope that the more experienced students do not throw their weight around, but that they understand my level and support me. I believe that with this group, this is possible. (Student, number 18)

Discussion and concluding remarks

This research aimed to describe the expectations of first-year healthcare students (N=97) regarding teaching, studying, and learning in VR and SBLEs. In addition, it measured students' expectations of their instructors, academic self-perception, and atmosphere. For these purposes, the DREEM questionnaire (Roff et al., 1997) and questionnaires that have been used to measure meaningful learning (Nevgi & Löfström, 2005; Hakkarainen, 2007) were selected; however, they were revised for the purposes of this research in order to identify students' expectations. Additionally, a little space was provided for students to answer an open-ended question, which was used here to contribute to the quantitative analysis. Sixty-five items were transformed into six subscales. Each subscale's Cronbach's *alpha* was quite high, which indicates both an acceptable internal consistency and that the variables can be used to describe students' expectations (Nunnally, 1978). Although this study's results are consistent with the results of previous studies, there is a need for more investigations to be sure that this questionnaire can be used as a valid measure of students` expectations. Men (n=15; 15.5%) and women (n=82; 84.5%) were both represented in different fields of education; thus the target group was quite consistent. Although the gender distribution was uneven, it followed the distribution normally found in healthcare education in Finland (e.g., Saarenmaa, Saari & Virtanen, 2010). However, the uneven distribution of gender was the reason this study did not attempt to determine differences in expectations between the genders.

It is also acknowledged that this study was not profound. For example, academic self-perception is an extensive research field, so profound understanding of this concept could have been reached by studying it on its own (e.g., Valentine, DuBois & Cooper, 2004). In addition to the questionnaires, the interviews could have provided additional information, for example, about the reasons the students did not expect much from their academic self-perception. However, this study provided us with useful information concerning students' expectations about learning in VR and SBLE, which could be used to develop a more user-centred pedagogical model and education for these environments.

As a result of the analysis, the sum variables expressing students' expectations of VR and SBLEs were named as follows:

1. Inspiring and individually tailored teaching;
2. Individual and competence-based studying;
3. Transferable learning outcomes;
4. Competent and well-prepared instructors;
5. Confident and competent students (academic self-perception); and
6. A relaxed and comfortable atmosphere.

Overall, students had high expectations of the activities involving VR and SBLEs. In all cases, over half of the students expected quite a lot or a lot from the learning process that takes place in VR and SBLEs, while there were only a few students who expected nothing or little. The adult learners especially seemed to have high expectations, compared to younger students. Previous findings about students' expectations have also indicated that students have high expectations of their learning environment (Amin et al., 2009; Draper & Louw, 2007; Miles & Leinster, 2007). The results of this study indicate that students had, on average, the highest expectations regarding their learning and their instructors, although the difference between the means and standard deviations of the sum variables was small. Students particularly expected that what they learned would be transferable, so that after training in the learning environment they would be competent. The students also expected quite a lot from their instructors. It was important for students that instructors are competent and well prepared for teaching, and that they provide clear examples. These results place high demands on education and educators. Therefore, we should consider these expectations as advice, and take them into account when organising approaches to teaching and studying. Otherwise, unmet expectations could lead to dissatisfaction. Learning is also inherently individual (De Corte, 1995), and students in this study expected that teaching would be individually tailored and that studying would be self-directed (cf. Keskitalo, Ruokamo & Väisänen, 2011). Therefore, this study suggests that special attention should be paid to students' individuality.

Students' academic self-perception was the lowest of all sum variables, although it was still positive. One explanation could be that students were aware that they were going into a new school and that they were going to train in a new type of learning environment, which could unexpectedly reveal their level of competence (cf. Cleave-Hogg & Morgan, 2002). Thus, at the same time, they were a little insecure about their skills and knowledge but were also quite positive that they could manage the exercises, pass the course, and be well prepared for their profession. On the other hand, 84.5% of the participants were female, and females have a tendency to underestimate their own performance (Chevalier, Gibbons, Thorpe, Snell & Hoskins, 2009). This could be one reason why academic self-perception was the lowest sum variable. However, it seems that students had somewhat realistic perceptions of themselves as learners, which is a good prerequisite for learning. It is certainly better than having too positive or too negative a view about oneself as a learner, which could hamper learning (Chevalier et al., 2009; Valentine et al., 2004).

Nevertheless, emphasising reflection during teaching and learning could enhance students' awareness of their own level of competence as well as protect their emotional well-being (cf. Chevalier et al., 2009; Stringer & Heath, 2008). As Barrows and Tamblyn (1980) have stated, students need to learn to recognise their own knowledge gaps - what they know and what they do not know. Students' expectations of their learning atmosphere were also moderately high in this study. These expectations could be quite easily met, since previous researchers have stated that students enjoy learning in these environments (Holzman et al., 1995; Keskitalo et al., 2010; McManus & Sieler, 1998; Moule et al., 2008).

This article is part of a larger study whose overall aim is to develop a pedagogical model for VR and SBLEs using a design-based research method, which is based on continuous cycles of design, enactment, analysis, and redesign (Brown, 1992; Design-based Research Collective, 2003). The first phase consisted of thematically interviewing teachers, the goal of which was to reveal the learning concepts, approaches to teaching, and educational tools that ENVI teachers use (Keskitalo, 2011). The purpose for the second phase was to find out what kinds of expectations students have regarding VR and SBLEs (see also Keskitalo, 2009). In a third phase, the purpose will be to design a pedagogical model according to the theory and results of the previous research, and to enact and redesign the model (Keskitalo et al., 2010). In the enactment phase, the purpose will be to also collect data regarding students' expectations, as well as to collect data from their experiences in these environments. This will enable us to detect the areas in which the students' expectations were not met. Eventually, an effective pedagogical model should be able to make teachers aware of the different choices and means available for teaching, and to help in the planning, realisation, and evaluation of education in VR and SBLEs.

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Healthcare facilitators' and students' conceptions of teaching and learning – An international case study

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ABSTRACT

Conceptions of teaching and learning affect approaches to teaching, learning and learning outcomes, and they therefore need to be made explicit. This study addresses how healthcare simulation facilitators and students view teaching and learning. Qualitative data from 43 participants in the field of healthcare was analyzed using the qualitative-content analysis method. The results revealed three distinct categories of conceptions of teaching and learning as well as two categories of conceptions of teaching within the context of a simulation-based learning environment. This knowledge can be used to understand and modify healthcare facilitators' and students' conceptions in order to enhance the learning experience.

1. Introduction

It is necessary not only to develop innovative and modern learning environments, but also the pedagogical basis of such environments. As Entwistle and Peterson (2004) write, even the most innovative learning environments will support learning only if they are also based on well-established educational principles (p. 425). Vermunt and Vermetten (2004) also state that the need for innovative and constructive teaching methods is increasing, because people are becoming dissatisfied with more traditional educational programmes that are based on teacher control and knowledge transfer. In medical education, virtual reality (*VR*) and simulation-based learning environments (*SBLEs*) are highly appreciated, since they have been shown to provide students with experiential learning opportunities and realistic environments in which to practice the actual work of healthcare personnel (Cleave-Hogg & Morgan, 2002; Kneebone, 2003; Rosen, 2008). According to Rall and Dieckmann (2005), "simulation, in short, means to do something in the 'as if', to resemble 'reality' (always not perfectly, because then it would be reality again), e.g. to train or learn something without the risks or costs of doing it in reality" (p. 2). In this study, the term VR is used to refer to a combination of techniques that are used to create and maintain real or imaginary environments (Cobb & Fraser, 2005; Riva, 2003).

However, new types of learning environments like VR and SBLEs require teachers to change their teaching practices and adapt their roles to become a facilitator of student learning (Keskitalo, 2011; Lonka, Joram, & Bryson, 1996; Lowyck, Lehtinen, & Elen, 2004). In addition, in order for students to understand their subject matter, they need to be able to change their views

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of teaching and learning and their approaches to studying, which have often been developed in traditional learning environments, such as classrooms or lecture halls (Kember, 2001). This task is not easy, since these personal and experience-based conceptions of teaching and learning are quite resistant to change (Entwistle & Peterson, 2004; Lonka et al., 1996) and are often ill-suited to new kinds of learning environments. Conceptions of teaching and learning affect approaches to teaching and learning, as well as the learning outcomes (Entwistle, Skinner, Entwistle, & Orr, 2000). Both teachers' and students' conceptions of teaching and learning have been studied fairly extensively since 1979 across different fields of enquiry and at different educational levels. However, most of the work was done within university settings, following Säljö's (1979) publication of a pioneering study on the conceptions of learning. The expansion of constructivist theories has since extended this line of research (e.g. Entwistle & Peterson, 2004; Lonka et al., 1996; Loyens, Rikers, & Schmidt, 2009; Marton, Dall'Alba, & Beaty, 1993; Tynjälä, 1997). There has been little published research on conceptions of teaching and learning among healthcare teachers and students. The present study therefore examines both teachers' and students' conceptions of teaching and learning within the specific arena of healthcare SBLE. Currently, it is not fully known how learning occurs in this type of environment, nor how to optimize that learning (Cook et al., 2011; Helle & Säljö, 2012). This study stresses the importance of facilitators' and student's conceptions of teaching and learning, which can be important determinants of their teaching or learning experience and outcomes.

As part of a larger study involving the development of a pedagogical model for VR and SBLEs in the field of healthcare employing design-based research (*DBR*) method (Brown, 1992; Collins, Joseph, & Bielaczyc, 2004; Design-Based Research Collective, 2003; see also Keskitalo, 2011; Keskitalo et al., 2010, 2011), the data was collected using various methods from two different continents in spring 2009 and 2010. The study included 13 facilitators and 30 students in the field of healthcare. Qualitative data was analyzed using the qualitative-content analysis method (Brenner, Brown, & Canter, 1985; Graneheim & Lundman, 2004) to answer the research question: *How do healthcare facilitators and students view teaching and learning?* In the present study, teachers are referred to as facilitators, since the role of a teacher in an SBLE is more focused on facilitating student learning. In terms of the development of a pedagogical model, it is expected that this research will provide important insights into how to design instruction within SBLEs that would better meet the needs and expectations of students and facilitators for teaching and learning.

The following sections introduce the theoretical background, research question and methods, and present the results. The results are then discussed and the implications for educational practice and future research are given.

2. Theoretical framework

2.1. Prior empirical work on conceptions of teaching

Within the present study, the phrase 'conceptions of teaching' refers to facilitators' and students' assumptions and beliefs about teaching (e.g. Vermunt & Vermetten, 2004). These conceptions are also referred to as mental models or beliefs (Vermunt, 1996; Kember, 1997). A conception can generally be understood as a framework within which an individual interprets and understands a certain phenomenon. As has been noted, conceptions are both intuitive and personal, since they are developed through experience (Entwistle & Peterson, 2004; Lonka et al., 1996; Loyens et al., 2009; Vermunt & Vermetten, 2004). Some researchers have suggested that conceptions are relatively stable and resistant to change (Entwistle & Peterson, 2004; Richardson, 2011), while others have argued that they can be affected by certain kinds of instruction and learning environments (e.g. Cano, 2005; Keskitalo, 2011; Lonka et al., 1996; Postareff & Lindblom-Ylänne, 2008; Postareff, Lindblom-Ylänne, & Nevgi, 2007; Tynjälä, 1997; Vermunt & Vermetten, 2004). Most importantly, these conceptions affect teachers' approaches to teaching, which, in turn, are related to students' approaches to studying and their academic performance (Kember, 1997). Previous studies have identified several categorizations of conceptions of teaching (see Table 1), which resemble each other to some extent.

Previous studies have defined two broad categories of conceptions of teaching: 'teaching as transmission of knowledge' and 'teaching as learning facilitation' (Kember, 1997, 2001; Kember & Kwan, 2000; Postareff & Lindblom-Ylänne, 2008), and some have argued that all the other conceptions discussed in previous research fall somewhere between these two (Kember, 1997). The first category includes the sub-categories of 'teaching as passing information' and 'teaching as making it easier for students to understand', and the latter category includes the sub-categories of 'teaching as meeting students' learning needs' and 'teaching as facilitating students to become independent learners'. The conception of teachers as knowledge transmitters is typical of teachers who have adopted a teacher-centred approach to teaching, whereas the view of teachers as facilitators of students' learning is a common conception among teachers who have adopted a student-centred approach to teaching (Kember & Kwan, 2000; Postareff et al., 2007; Postareff & Lindblom-Ylänne, 2008). Generally, the teacher-centred view of teaching, is that knowledge is constructed by the teacher and evaluated via quantitative means, whereas in the student-centred view, the aim is to facilitate students' learning using a broad repertoire of teaching and assessment methods. Earlier studies have shown that if teachers adopt a teacher-centred approach to teaching, students are likely to adopt a surface approach to learning: that is, memorizing facts or remembering the course content. However, if teachers adopt a student-centred approach to teaching, students are likely to aspire to a deeper understanding of knowledge (Boulton-Lewis, Smith, McCrindle, Burnett, & Campbell, 2001; Entwistle et al., 2000). Lueddeke (2003) reported that these approaches were somewhat domain-specific, while Kember (1997) found that students tended to prefer courses that were in line with their own conceptions and approaches. In addition, Keskitalo (2011) found that healthcare teachers generally saw

Table 1
Conceptions of teaching.

Author	Conception of teaching						
Dall'Alba, 1991	(1) Presenting information	(2) Transmitting information from teacher to student	(3) Illustrating the application of theory to practice	(4) Developing concepts and principles through interaction with students	(5) Developing the capacity in students to be experts	6) Exploring ways of understanding from particular perspectives	(7) Bringing about conceptual change in students
Samuelowicz & Bain, 1992	(1) Imparting knowledge	(2) Transmission of knowledge and attitudes in discipline	(3) Facilitating students' understanding of the course content	(4) Changing students' conceptions of the world	(5) Supporting students' learning		
Kember & Kwan, 2000	(1) Teaching as transmission of knowledge		(2) Teaching as learning facilitation				
Boulton-Lewis et al., 2001	(1) Transmission of content/skills		(2) Development of skills/understanding	(3) Facilitation of understanding		(4) Transformation	
Postareff & Lindblom-Ylänne, 2008	(1) Content-focused		(2) Learning-focused				

teaching through VR and SBLEs as facilitation of students' learning. Lowyck, Elen, and Clarebout (2004) have also proposed a relatively new term "instructional conception", which aims to clarify the current discussion on conceptions of teaching and learning. Instructional conception is linked to students' ideas about the learning environment, the learning process, and the learning outcomes as well as knowledge.

2.2. Prior empirical work on conceptions of learning

As with the conceptions of teaching, the term 'conceptions of learning' also refers to assumptions and beliefs about learning. Conceptions of learning are known to affect students' perceptions of the learning environment, the approach they adopt to studying and their academic performance (e.g. Bliuc et al., 2010; Cano, 2005; Lindblom-Ylänne & Lonka, 1999). Learning conceptions are also viewed as domain- (Lonka et al., 1996) and context-specific (Vermunt & Vermetten, 2004), and some conceptions are more common among certain ethnic groups than others (Richardson, 2010). However, there is evidence of students altering their conceptions of learning, since more sophisticated conceptions are related to more involved approaches to studying and, in some cases, improved learning outcomes (e.g. Cano, 2005; Lindblom-Ylänne & Lonka, 1999; Vermunt & Vermetten, 2004). Teachers' and students' conceptions of learning have been studied both quantitatively and qualitatively since the 1970s, although the phenomenographic methodology has predominated (Marton, 1981). Starting with Säljö (1979), the research literature has defined several somewhat related conceptions of learning (see Table 2).

In the first few categories, learning is seen mostly as acquiring knowledge by rote learning and consigning it to memory. The teacher's role is to provide ready-made information, and the student is seen as a passive recipient of this information. At the opposite end of the conceptions' spectrum, learning is seen as a constructive and transformative process, whereby students construct, interpret and produce knowledge. This kind of learning is also more active, creative and interactive. In some of the latter categories, learning is also seen as quite a fundamental process, since it may influence the learners' personal development and ways of thinking (e.g. Boulton-Lewis et al., 2001; Marton et al., 1993; Säljö, 1979). The former categories have been defined as 'reproductive' (Säljö, 1979) and less successful for students' learning, whereas the latter categories, being more sophisticated, are related to more effective studying strategies and improved learning outcomes. This is also why the latter categories are often viewed as being better (Kember, 1997). Tynjälä (1997) examined education students' conception of the learning process, what the learning process was like and how learning took place. Tynjälä (1997) identified seven distinct categories of the learning process; namely, (1) learning as an externally determined event/process, (2) learning as a development process, (3) learning as a student activity, (4) learning as styles/strategies/approaches, (5) learning as information processing, (6) learning as an interactive process, and (7) learning as a creative process. However, according to Marton et al. (1993), the learning process is just one aspect of the conception of learning.

Teachers and students approach innovative learning environments through their existing personal and experience-based conceptions, which may be unsuitable for a new educational environment. In addition, the achievement of understanding and developing deeper learning also encourage conceptual changes among students. Researchers have suggested several ways to promote understanding and deeper learning, including fostering metacognitive skills and metacognitive awareness (Tynjälä, 1997), transformative learning (Mezirow et al., 1990), activating instruction (Lonka et al., 1996), teaching for understanding (Entwistle & Peterson, 2004) and process-oriented instruction (Vermunt & Vermetten, 2004). These approaches share the common aim of activating and critically evaluating existing conceptions through reflective thinking and shifting them in a more progressive direction. Postareff et al. (2007) found that teachers' conceptions and approaches to teaching were likely to become more conceptual change/student-focused if pedagogical training lasted at least one year. Pedagogical training made teachers more aware of their teaching habits and such awareness is essential in improving teaching practices. Previous authors have also suggested that to be effective, intervention should address all of the components of learning, such as conceptions of learning, and individuals' perceptions of the learning environment and of themselves as learners (Postareff & Lindblom-Ylänne, 2008; Postareff et al., 2007; Richardson, 2011; Vermunt & Vermetten, 2004).

3. Research question and methods

The present study is part of the development of a pedagogical model for VR and SBLEs within the healthcare sector. The pedagogical model will be developed on the basis of the DBR method, which utilizes continuous and iterative cycles of design, enactment, analysis and redesign (Brown, 1992; Collins et al., 2004; Design-Based Research Collective, 2003). The first- and second-cycle data presented and analyzed in this study was collected from the Arcada University of Applied Sciences in April and May 2009 and from two of Stanford University's simulation centres between February and March 2010. The study addresses the following research question: *How do healthcare facilitators and students view teaching and learning?* To develop a pedagogical model, it is useful to determine how teachers and students view teaching and learning so as to better meet their expectations and needs and to provide appropriate support.

3.1. Data collection

Various methods were used to collect empirical data from the two institutions (see Table 3). The Arcada data was gathered during a seven-week course titled *The treatment of critically ill patients*; the course was attended by second-year

Table 2
Conceptions of learning.

Author	Conceptions of learning					
Säljö, 1979	(1) Learning as a quantitative increase in knowledge. Learning is acquiring information or knowing a lot.	(2) Learning as memorizing. Learning is storing information that can be reproduced.	(3) Learning as acquiring facts, skills, and methods that can be retained and used as required.	(4) Learning as making sense or abstracting meaning. Learning involves relating parts of the subject matter to each other and to the real world.	(5) Learning as interpreting and understanding reality in a different way. Learning involves comprehending the world by reinterpreting knowledge.	
Marton et al., 1993	(1) Increasing one's knowledge	(2) Memorizing and reproducing	(3) Applying	(4) Understanding	(5) Seeing something in a different way	6) Changing as a person
Bruce & Gerber, 1995	(1) Acquiring knowledge through the use of study skills in the preparation of assessment tasks	(2) The absorption of new knowledge and being able to explain and apply it	(3) Development of thinking skills and the ability to reason	(4) Developing competencies of beginning professionals	(5) Changing personal attitudes, beliefs, or behaviour in response to different phenomena	(6) Learning as a participative pedagogic experience
Boulton-Lewis et al., 2001	(1) Acquisition and reproduction of content/skills	(2) Development and application of skills/un derstanding	(3) Development of understanding	(4) Transformation		
Paakkari et al., 2011	(1) The reproduction of acquired health knowledge	(2) The application of health knowledge	(3) Developing personal meanings on health matters	(4) The transformation of individual thinking	(5) Personal growth	(6) Collective meaning-making

Table 3
Data collection and analysis methods and data sources.

Data collection method	Data source		Data analysis method
(1) Individual interviews	Stanford: Facilitators ($n = 1$) 1 Emergency medicine course	Arcada: Students ($n = 14$), Facilitators ($n = 4$) *The treatment of critically ill patients* course	Qualitative content analysis
(2) Group interviews	Stanford: Facilitators ($n = 8$), Students ($n = 16$) 2 Anaesthesia crisis resource management II courses, 1 Critical care core clerkship course, 1 Emergency medicine clerkship course	Arcada: –	Qualitative content analysis
(3) Open answers to pre- and post-questionnaires	Stanford: –	Arcada: Students' open answers of pre- ($n = 10$) and post-questionnaires ($n = 13$) *The treatment of critically ill patients* course	Qualitative content analysis
(4) Learning diaries	Stanford: –	Arcada: Students ($n = 10$) *The treatment of critically ill patients* course	Qualitative content analysis

paramedic students ($n = 14$) and facilitators ($n = 4$), whose specialties were nursing, paramedics and anaesthesia. For the most part, the students had upper-secondary school background, but some of them had already worked in the field of healthcare. The Stanford students ($n = 16$) were mainly second-year anaesthesia residents, and third- and fourth-year medical students, whereas the facilitators' ($n = 9$) specialties were anaesthesia, emergency medicine and nursing. At Stanford medical school, students study for four years to learn theoretical knowledge of medicine. Residency training is required to practice in the chosen field of specialization. At Stanford, data was collected from five different courses, which lasted from three to nine hours. At both universities and for all courses, the activities were created by the facilitators and were conducted in group format. During the training, students worked in teams on scenarios (i.e. cases) related to topics such as patients who were having a myocardial infarction (heart attack), and each case was subsequently assessed via a debriefing session. The structure of the course involved an introduction, a simulator briefing, scenarios and a debriefing (see *Learning through Simulation* model, Joyce et al., 2002). At Arcada, students also had lectures and periods of self-study. Those students who were not taking part in a case scenario watched it from a separate room via closed-circuit television. The simulations were organized in a similar fashion in both Arcada and Stanford.

The simulation centres comprised separate rooms where students were able to practise specific skills or go through entire scenarios related to the content areas. In both studies, one room was used and equipped for students' to rehearse in. The room contained a patient simulator for which the vital signs were displayed on a monitor. Next to this room was a place from which the facilitator was able to control the simulator and guide the students' learning process via audio devices. One room was dedicated to debriefing, where appropriate technology, such as video and audio-recording devices, was available. Video and audio recordings were used in debriefing sessions to complement the students' process of reflection. Both experiments were given prior approval by the institutional review boards and informed consent was obtained from all participants. This article includes analyses of qualitative data, including (1) *individual interviews* ($n = 19$), (2) *group interviews* ($n = 24$), (3) *open answers on pre-* ($n = 10$) *and post-questionnaires* ($n = 13$), and (4) *learning diaries* ($n = 10$). The data-collection and analysis methods and the data sources are presented in Table 3.

1) In terms of data collection, structured interviews were carried out at the end of the Arcada University course in May 2009. The interviews ranged in length from 25 to 90 min. Facilitators were asked questions related to the concepts of teaching and learning (e.g. *How do you think people learn? Describe learning as you understand it*) and the pedagogical model (e.g. *How did you utilize the pedagogical model in your teaching?*). Students were asked questions related to the concepts of teaching and learning (e.g. *How do you think people learn? Describe learning as you understand it*) as well as questions related to the pedagogical model (e.g. *How did the facilitator take the students' prior experiences into account?*). In addition, free and open-ended discussion was encouraged. At Stanford, one facilitator was interviewed individually and the questions were similar to those posed to the Arcada in 2009.
2) At Stanford, group interviews were considered as the appropriate data-collection method due to the long study days and subsequent time restrictions. These group interviews were first constructed, tested using a group of students, and then revised by the first two authors of this study; the pilot interviews are not included in the analysis. The actual group interviews that were used in this study were recorded following the simulation activities in February and March 2010. The first author interviewed the students while the second author was interviewing the facilitators. There were four facilitator group interviews (the facilitators were interviewed in pairs) and three student group interviews. Each of the interviews lasted approximately 30 min. Facilitators and students were asked questions that were similar to those used in Arcada in 2009.
3) Pre- and post-questionnaires were given to the Arcada students at the beginning and end of the course in 2009. The pre-questionnaire consisted of Likert-type questions related to the students' expectations of the facilitating, training and learning processes in an SBLE, as well as open questions about teaching (*What is teaching? Describe teaching as you understand it*), the course facilitator (*Describe what a good facilitator is like.*), training (*What kind of training should a*

simulation-based learning environment incorporate that would promote learning?) and learning (e.g. *What is learning? Describe learning as you understand it*). The post-course questions were similar to those used in the pre-questionnaire, but dealt with students' experiences. At Stanford, students also completed the questionnaires, but, due to time restrictions, the open questions were removed and asked during the group interviews.

4) At the Arcada University of Applied Sciences the students wrote learning diaries at the end of every session in the simulation centre to document their experiences, thoughts, feelings and ideas related to the learning process in the SBLE.

3.2. Data analysis

The qualitative data collected at Arcada was transcribed by two research assistants, whereas the data collected at Stanford was transcribed by a transcription service. The data was then analyzed using the qualitative-content analysis method by the first author of this study (Brenner et al., 1985; Graneheim & Lundman, 2004). Initially, the data collected from Arcada was analyzed separately and the results were presented at a conference (Keskitalo et al., 2011). During the second phase, the Arcada and Stanford data were combined and analyzed together. The analysis began by reading through the data to obtain an overall picture of the participants' responses. In the second phase of the analysis, the qualitative data was read again, and important sentences in the responses were underlined and codified with respect to the research question. In the third phase, categories were created from response codes that had the similar meanings. The data was also re-read if the meaning of the code was not clear or if there was uncertainty about how to label the category. During this phase, categories were also compared with those found in previous research in order to identify similarities and differences. As noted earlier, the analysis was an iterative process wherein the aim was to identify categories that emerged from the data.

4. Results

4.1. Facilitators' and students' conceptions of teaching

The iterative data-analysis process resulted in three distinct categories of conceptions of teaching namely, (1) Teaching as communicating knowledge and skills to students, (2) Teaching as development of students' skills and understanding, and (3) Teaching as facilitation of students' learning. These categories are understood as being hierarchical in nature, where the first category is a less developed and sophisticated view of learning, the second category falls in the middle and where teaching as facilitation of students' learning represents the most sophisticated approach (cf. Paakkari, Tynjälä, & Kannas, 2011; Postareff & Lindblom-Ylänne, 2008). The hierarchical nature of the categories means that the first two categories are included in the latter category. Therefore, a facilitator who sees teaching as the facilitation of students' learning may, on some occasions, use less advanced strategies, such as telling and modelling. Analysis also revealed that there were only minor qualitative differences between the responses of facilitators and students. Facilitators described teaching from their point of view: for example, they provide the learning environment and instruction to students; the students' perspective described what they wanted teaching to be: for example, inspiring and taking into account individual characteristics. Therefore, facilitators' and students' views of teaching were combined and analyzed together.

Category 1, *Teaching as communicating knowledge and skills to students*, represented a relatively common view of teaching. In this category, the focus is on facilitators and their expertise, which they disseminate to the students, as can be seen from the following description: 'Imparting your knowledge to other people' (*facilitator 04, group interview 03*). This approach views students as being rather passive and more like an audience for facilitators' presentations, as demonstrated by the following student statement: 'Teaching is bringing knowledge and skills to others' awareness. Hence, students have the opportunity to learn' (*student 03, pre-questionnaire*). In this category, teachers used a number of strategies, including showing, explaining, passing-on and communicating. In general, such teaching strategies tend to be quite restricted and inflexible. The facilitators' own interests, rather than the students' individual needs, are also the starting point for learning, as represented by the following statement 'I think we have a tendency to teach them what we want them to learn' (*facilitator 02, group interview 02*).

In the second category, *Teaching as development of skills and understanding in students*, teaching was described as modelling and explaining knowledge and skills to students, as the following facilitator explained: 'The teachers' task is to bind it [teaching] to something that already exists' (*facilitator 02, interview*). Facilitators tried to make the information understandable for students by explaining and giving examples. This relates to Kember and Kwan's (2000) sub-category 'teaching is making it easier for students to understand', wherein teachers try to structure information and make it easier for students to understand by using examples, ideas, and theories. However, in this category, the facilitator directs the learning process and determines the content to be studied and the students' are seen as rather passive, although their individual characteristics are accommodated to some extent, as can be seen from the following student's definition of teaching: 'Taking into account strengths and weaknesses of the individual, so that you can get the things across to everyone' (*student 01, interview*).

In the third category, *Teaching as facilitation of students' learning*, the focus was on students and their learning, as the following facilitator described: '[Teaching is]... a little more about creating experiences by which they [students] can learn on their own with some knowledge and guidance and advice from us' (*facilitator 03, group interview 03*). In this category, the facilitators' role was to provide the learning environment and use strategies that encouraged and motivated learners. Facilitators mentioned strategies such as guiding, instructing, helping, inspiring, engaging, encouraging, figuring out and discussing. The students' role was seen as being active and more equal to that of the facilitators. Students were described as being more independent and capable of finding answers by themselves, whereas the facilitator was more like a resource from which students to could benefit, as the following student described: 'The teacher is supportive, you can ask them if you can't understand something' (*student 09, pre-questionnaire*). One qualitative difference between facilitators' and students' descriptions was that students emphasized their roles as individuals; hence, for the students, it was important that the facilitator knew the students and took their individuality into account, as described in the following statement: 'The good facilitator knows the students, knows what they are capable of doing, and can develop them to the level that it is possible for each individual to attain' (*student 02, pre-questionnaire*). Within this category, teaching approaches vary, as the following student described: 'Teachers have many operational strategies that help them to develop insights into individual students' (*student 13, interview*).

Analysis of the statements concerning teaching in an SBLE revealed two broad categories of conceptions of teaching: (1) *Teaching in an SBLEs as communicating knowledge and skills*, and (2) *Teaching in an SBLEs as facilitation of students' learning*. Although two categories were identified in the responses, teaching in an SBLEs was seen mostly as a process of facilitating students' learning, especially from the students' viewpoint. Interestingly, the facilitators were the ones who thought that the communication of knowledge and skills was also important in an SBLEs. In the first category, *Teaching in an SBLEs as communicating knowledge and skills*, facilitators directed the learning and showed the correct ways to practise skills and solve the problems, as the following facilitator said: 'You also need to be the one who conveys the knowledge to students and explains the essential points and, therefore, a more traditional kind of teacher' (*facilitator 02, interview*). However, this particular facilitator added that if the learners are beginners, then providing information and adopting a more traditional teaching role was more important, whereas in a professional group, facilitators have greater scope to act as guides and to create learning possibilities.

In the second category, *Teaching in an SBLEs as facilitation of students' learning*, the strategies that were used to enhance students' learning were instructing, assuring, helping, questioning, providing a learning environment, making the learning experience relevant, safe and fun, giving feedback and support, as well as being sensitive to students and their learning. One facilitator described this approach as follows: 'I think we want to take things that are relevant, we make it feel safe, we make it fun, we validate students' own insights into their own behaviour' (*facilitator 05, interview*). Within an SBLE, the facilitator's role is more to create opportunities for learning and to fade into the background, thereby giving students the opportunity to actively practice their skills, apply knowledge, and to come to their own conclusions with the help of their peers and the facilitator, as illustrated by the following excerpts:

> I think it's mainly just learning from your mistakes and receiving constructive criticism afterwards. So I think having the session where we go in and do what we think is the best thing; and then coming back and actually hearing feedback not only from the superior but from your colleagues as well. (*student 07, group interview 02*)

> There the role is more like that of a facilitator, I don't necessarily think that the teacher is one who can tell and advise and is like a classical teacher, but in the simulation, I think, that I am more like one who helps the students have insights. (*facilitator 01, interview*)

4.2. Facilitators' and students' conceptions of learning

Three conceptions of learning clearly emerged from the data as a result of the iterative analysis process, namely (1) *Learning as acquiring and reproducing knowledge and skills*, (2) *Learning as advancing and applying knowledge and skills*, and (3) *Learning as a transformative process*. Of these three conceptions, the second was the most commonly expressed, whereas the third was least common. Once again, there were only minor differences between the answers of the facilitators and students, so the answers are presented together here.

In the first category, *Learning as acquiring and reproducing knowledge and skills*, the focus is on the content that students receive by using various study strategies, for example reading, reflecting and listening. Following the basic learning stage, students know more and know how to carry out certain procedures, as the following excerpt shows: '... so that you can do things after you have graduated' (*student 05, interview*). In this category, the main purpose of studying is to acquire, remember and repeat knowledge and skills, not necessarily to apply them.

The second category, *Learning as advancing and applying knowledge and skills*, was the most common one; it included most of the participants' statements. In this category, the focus was clearly on students and the development of their competence. This concept of learning emphasizes the purpose of acquiring knowledge – for example, applying it to solve medical problems encountered during the scenario phase, as the following facilitator described: 'We set the scene for it; we have the residents carry out various tasks and manage it. We don't interfere too much with that' (*facilitator 01, group interview 02*). Students whose conception of learning fell within this category tried to attain competence by doing and by practicing. While practicing, they were actively combining theories and practice, repeating, solving problems, reflecting and discussing. Making mistakes was also mentioned as a typical way of learning in an SBLE, as student described: 'Well, how you learn is quite individual, but speaking for myself, I can say that I learn quite a lot from my mistakes' (*student 11, interview*). Other students confirmed that, following the training and studying, they learned particularly from their mistakes: 'You remember the mistakes that you make, you know? So then you also remember the mistakes that other people make, and so you'd rather make them here than with a real patient' (*student 15, group interview 03*). Following the learning process, students were able to understand and apply the knowledge in practice and to generalize the knowledge to other things: 'Learning is active internalizing of knowledge and skills. After learning, students can then apply the learned things to practice' (*student 03, pre-questionnaire*). According to the participants in the study, learning also makes them more independent, experienced and better prepared.

Although it was a less common category, there was some evidence that the conception of *Learning as a transformative process* also exist among the participants, as there were statements that did not fall into either of the two previous categories. In this third category, the focus is on the students and on facilitating their development as individuals. Here, the aim is for students to learn through experience and critical thinking, as the following facilitator described: 'And then we hope, when we talk in the debriefing, to kind of figure out what they do, why they do it, and where the gaps are' (*facilitator 01, group interview 02*). As a consequence of this process, students are able to 'recognize *why* they think as they think or *why* they behave as they behave' (Paakkari et al., 2011, p. 709). In addition to assessing their current status, they are also able to acknowledge how they should develop themselves further. The learning process is, therefore, not perceived simply in terms of an increased ability to do and recall things, but acknowledges learning as a lifelong process:

> Well, in a way, here you have a good basis for that, how you have to keep learning after your studies are over so that the learning never stops; that, in a way, you have to keep up the proficiency, because otherwise it will continually decline; that you have to bone up on literature all the time and ... do those things in practice... (*student 06, interview*)

One of the participants also acknowledged that learning can change one as a person (cf. Marton et al., 1993):

> Student: Many things are like, ... you can understand them, but like you can start an all-round education.
> Interviewer: Yes.
> Student: What you are taught in comprehensive school, is to understand things; but you don't have to process them, you never confront them, they don't mean anything.
> Interviewer: Yes.
> Student: What you learn changes nothing in you. (*student 13, interview*)

5. Discussion and implications

From a teaching perspective, the participants hold quite typical conceptions of teaching. On the one hand, teaching was viewed as a process of transmitting knowledge and skills to students, thus making the students passive recipients of information and placing the teacher in a central position in the learning process. In the second category of conception of teaching, teachers move closer to the students and consider them when providing information and skills that are felt to be interesting and important. In the third category, teaching was viewed solely as a student/learning-centred activity. However, even within the SBLE, teaching was mostly seen as a student-centred activity, and the facilitators acknowledged their role as facilitators of students' learning.

As for conceptions of learning, the participants' responses indicated three distinct conceptions, moving from acquiring and reproducing, to application and development, then to transformation of oneself both as an individual and as a professional. In most cases, the learning process was seen as advancing and developing the competence of students through doing and practicing (cf. Bruce & Gerber, 1995). However, this may be expected within the present context, as learning how to apply knowledge and skills in order to manage and care for patients is an important aim in the field of healthcare (cf. *professional orientation*, Lindblom-Ylänne & Lonka, 1999; Vermunt & Vermetten, 2004).

The present study included a relatively large group of participants in the investigation of this previously unexplored field; it was therefore expected that the study would reveal categories of teaching and learning conceptions that differed from those found in previous research (Boulton-Lewis et al., 2001; Bruce & Gerber, 1995; Kember, 1997; Keskitalo, 2011; Postareff & Lindblom-Ylänne, 2008). Contrary to our expectations, however, this study did not find significantly different categories from those found in previous research. This indicates that the conceptions are somewhat parallel, despite the differing context, which confirms the results found by Paakkari et al. (2011). In our opinion, the study participants hold quite sophisticated views of teaching and learning, since teaching was viewed mostly as the facilitation of learning, and learning as the application and advancement of knowledge and skills (cf. Lindblom-Ylänne & Lonka, 1999), and not so much as the simpler construct of transmitting and acquiring knowledge and skills. This may have resulted from the use of the SBLE, where the students' own activity is strongly encouraged and the facilitators' role is to guide this activity (cf. Keskitalo, 2011; Tynjälä, 1997). Therefore, providing an exploratory learning environment could be one approach to changing both teachers' and students' conceptions of teaching and learning (Richardson, 2010).

Although our findings were generally similar to those of previous studies, there were also some differences. In the categories used in our study, the facilitation of students' professional development through doing and experiencing was quite a dominant viewpoint (cf. Lindblom-Ylänne & Lonka, 1999), unlike in some previous studies, where the participants considered the focus of teaching and learning to be the construction of meaning (Boulton-Lewis et al., 2001; Paakkari et al., 2011). Within the present study, collective meaning-making and personal meaning-making were not mentioned as important in learning (cf. Paakkari et al., 2011), despite the special emphasis on reflection in the debriefing following the simulation-based learning. Referring to Paakkari et al. (2011), there are obviously differences in the aspects that people consider to be important in teaching and learning, which is a reflection of the importance attached to the so-called professional orientation in healthcare education. However, we should also remember that our participants were students and healthcare professionals, and had not been formally trained as educators, so providing answers corresponding to the views expressed within the current academic literature on teaching and learning would have been somewhat unexpected (cf. Lonka et al., 1996). Although some of the participants were very aware of their own conceptions and approaches, others were not able to elaborate their views in detail. As Postareff and Lindblom-Ylänne (2008) put it, the participants in our study differed in their pedagogical awareness. However, Kember (1997) has also stated that conceptions of teaching – as well as the conceptions of learning – have developed 'through some complex amalgam of influences' (p. 271), so that education is not the only influence on these conceptions. Furthermore, our data-collection method did not make it possible to distinguish individual views which could have produced more varied perspectives on teaching and learning (cf. Paakkari et al., 2011), and allow comparison between conceptions of teaching and learning (cf. Boulton-Lewis et al., 2001). Nevertheless, the purpose of this study was not to detect individual differences, but to examine the conceptions as a whole. The findings confirm that the conceptions form a hierarchy rather than a continuum (cf. Paakkari et al., 2011; Tynjälä, 1997; Säljö, 1979), since the research structure allowed each participant to express more than one conception, for example, depending on the students' characteristics. However, based on the results of this study, the question of whether the different categories of teaching and learning elaborated in this study form a strict, well-defined hierarchical system or whether the boundaries between the categories are blurred, remains unanswered.

This study suggests that although teaching and learning were seen as student-centred and effort-demanding activities, there may be students who expect direct guidance and ready-made information, since teaching was seen by some students as the communication of knowledge and skills to students and learning was viewed as the acquisition and receiving of information from teachers. Consequently, students may feel uncomfortable with new learning environments and pedagogical methods if such teaching approaches do not correspond to their views of teaching and learning (cf. Kember, 1997, 2001). In addition, some teachers may also feel challenged when teaching in SBLEs if they have views of teaching and learning that are incompatible with these environments. However, Kember (2001) and Tynjälä (1997) argued that the learning environment and the methods used can affect teachers' and students' conceptions. Therefore, introducing new environments in combination with appropriate pedagogical methods may help persuade teachers and students to adopt conceptions that are more student-centred and constructivist (Entwistle & Peterson, 2004; Lonka et al., 1996). Kember (2001) also suggests that providing time and support is essential for students' learning and eases the transition towards more innovative pedagogical practices. When teachers find themselves in a new environment, they may also have to develop and rethink their teaching practices when they notice their established methods are unsuitable for the new conditions (Keskitalo, 2011). For teachers, this means they must be able to recognize and change their teaching practices and take advantage of the opportunities provided by the new environment. Neither teachers' nor students' conceptions are likely to change if teaching practices remain based on factual material structured by the teacher (Kember, 2001). Long-lasting pedagogical education has also been noted as effective in aiding teachers' conceptual development (Postareff et al., 2007).

The present study has a number of limitations. Firstly, some participants were interviewed individually, whereas others participated in group interviews. Therefore, the data collected through group interviews is less extensive than that collected from individuals. This could also be one reason why we were able to detect only three categories of teaching and learning. Secondly, some individuals participated only in the interviews, while others also completed learning diaries, and pre- and post-questionnaires. Therefore, the data is somewhat unevenly distributed between the various data collection methods. However, the students' learning diaries and pre- and post-questionnaires were not as profound as we had expected. Thirdly, it is possible that the questions were interpreted differently than the researchers anticipated; therefore, the participants may have been addressing slightly different issues in their answers. This was potentially the case when the researchers were interviewing English-speaking participants, as English was not the interviewers' native language. Kember (1997) also notes that, although researchers categorize data based on the interviews and the wording of interviewees' responses, the interviewees themselves do not necessarily pay much attention to the words that they use. Self-reporting is one potential data-collection method, but it may not necessarily be the most appropriate. For example, combining the individual interviews and observations would be more useful. Fourthly, we should have asked questions about participants' conception of knowledge to determine what the facilitators' and students' conceptions really were, since conceptions of teaching and learning are also related to conceptions of knowledge and how it is viewed (Entwistle & Peterson, 2004; Kember, 2001; Paakkari et al., 2011). For this reason, future studies should include questions about conceptions of knowledge. It would also be useful to obtain data through more precise data-collection methods, e.g. through individual interviews. In addition, an alternative method of analysis might be appropriate. For example, a phenomenographic approach would help researchers form more precise categories and concentrate the data itself.

6. Conclusion

This study examined conceptions of teaching and learning among 43 students and educators within the healthcare sector. Despite the relatively large number of participants, the study did not identify any new categories from those previously reported in the literature. However, it can be viewed as a starting point for examining and defining conceptions of teaching and learning in the field of healthcare, especially within novel learning environments. It is also possible that an alternative research methodology, such as a phenomenographic approach, would produce different results. Therefore, we strongly encourage other researchers in the field to investigate whether there are differences between healthcare teachers' and students' conceptions and, to try to identify different categories from those generated in this study. In summary, this study provided information about facilitators' and students' views of teaching and learning. This knowledge can be used to understand and modify healthcare facilitators' and students' conceptions in order to enhance the learning experience. The information provided by the study is relevant to the design and development of more user-centred pedagogical models.

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Towards Meaningful Simulation-based Learning with Medical Students and Junior Physicians

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ABSTRACT

BACKGROUND: This research provides an educational perspective on simulation-based medical education by implementing both the characteristics of meaningful learning and the concepts of facilitating, training, and learning processes.

AIMS: This study aims to evaluate, from the perspectives of both facilitators and students, the meaningfulness of five different simulation-based courses.

METHODS: The courses were implemented in the spring of 2010. The data was collected from facilitators (*n* = 9) and students (*n* = 25) using group interviews (one individual interview), observations, video recordings, and pre- and post-questionnaires. The research analyzes qualitative data using the qualitative content analysis method to answer the following research question: From facilitators' and students' perspectives, how does the facilitating and training in simulation-based learning environments (SBLEs) foster the meaningful learning of students?

RESULTS: It seems that simulation-based learning is, at its foundation, meaningful since it inherently supports the many characteristics of meaningful learning. However, characteristics also exist that simulation-based learning does not inherently support. In this study, the goal-oriented, self-directed, and individual training characteristics were only somewhat supported during the facilitation and training in SBLEs.

CONCLUSIONS: In running these courses in the future, facilitators should concentrate on those characteristics that were only somewhat supported.

Keywords: simulation-based medical education, pedagogical model, meaningful learning, facilitating, training and learning process, qualitative case study, facilitators, students

INTRODUCTION

Advancement in technology, growing research, and proofs of its usefulness in learning has increased the use of simulators and simulation-based learning environments (*SBLEs*). However, this has happened only recently. (Gaba 2004; Rosen 2008.) Since the beginning of the 20^{th} century, innovations in other industries such as the aviation and military industries have pushed forward the development of medical simulations. In addition, the developments in technology and plastic have made it possible to create even more advanced simulators that attract healthcare teachers, students, and researchers (Rosen 2008). The quality of research in the field of simulation-based learning has also improved (McGaghie et al. 2010). Today, a growing body of research results are available that demonstrate that simulation-based learning is more than just fun (Rosen 2008); it is also effective (Cook et al. 2011; McGaghie et al. 2010). However, in order for simulation-based learning to be effective, it has to be planned appropriately (Kneebone 2003; McGaghie et al. 2010), taking into account educational principles and the nature of human beings. This research provides an educational perspective on simulation-based medical education. This is the first study to contribute to the field by implementing both the characteristics of meaningful learning (Ausubel 1968; Ausubel et al. 1978; Hakkarainen 2007; Jonassen 1995; Löfström & Nevgi 2007; Ruokamo & Pohjolainen 2000) and the concepts of the facilitating, training, and learning processes (cf.Kansanen et al. 2000; Uljens 1997).

The overall aim of this study is to facilitate meaningful simulation-based learning by developing a pedagogical model, namely the Facilitating, Training, and Learning (*FTL*) model, (Keskitalo et al. 2010) using the design-based research (*DBR*) method (Brown 1992; Collins et al. 2004; Design-based Research Collective 2003). The model will help practitioners in the field of healthcare to plan, implement, and evaluate their teaching, instructional materials, and curricula designed for simulation-based learning (Joyce & Weil 1980). This particular study aims to evaluate, from both the facilitators' and students' perspectives, the meaningfulness of five different simulation-based courses, which were implemented in the spring of 2010. The data was collected from facilitators (n = 9) and students (n = 25) using various data collection methods, including group interviews (one individual interview), observations, video recordings, and pre- and post-questionnaires. The research analyzes qualitative data using the qualitative content analysis method (Brenner et al. 1985; Graneheim & Lundman 2004) to answer the research question: *From facilitators' and students' perspectives, how does the facilitating and training in SBLEs foster the meaningful learning of students?* The paper introduces the theoretical perspectives and methods, and then presents and discusses the research results.

Facilitating, Training, and Learning Model as an Underlying Theoretical Framework

The Facilitating, Training, and Learning model (for a more detailed description see Keskitalo et al. 2010) is a synthesis of various theories and pedagogical models, namely the ideas of the teaching, studying, and learning process (herein referred to as facilitating, training, and learning) (Kansanen et al. 2000; Uljens 1997), characteristics of meaningful learning (Ausubel 1968; Ausubel et al. 1978; Hakkarainen 2007; Jonassen 1995; Löfström & Nevgi 2007; Ruokamo & Pohjolainen 2000) and the Learning through Simulation model (Joyce et al. 2002; Dieckmann 2009; Dieckmann et al. 2007). The FTL process implies that facilitating does not necessarily lead to learning, but that student activity is needed before learning can be attained (Kansanen et al. 2000; Uljens 1997). The concept of meaningful learning was first presented by Ausubel (1968), and later on, developed further by many authors in different contexts (e.g. Hakkarainen 2007; Jonassen 1995; Löfström & Nevgi 2007; Ruokamo & Pohjolainen 2000). For Ausubel and co-authors (1978), meaningful learning is a process where new information is related to what the learner already knows. In meaningful learning, both the learning materials and task must be meaningful and the learners must engage themselves in a meaningful learning process (Ausubel et al. 1978). Continuing the work of Jonassen (1995) and others (e.g. Hakkarainen 2007; Jonassen 1995; Löfström & Nevgi 2007; Ruokamo & Pohjolainen 2000), the fourteen characteristics of meaningful learning are used here to describe, foster, and evaluate the meaningful learning of students in SBLEs; therefore, special emphasis is given to them. The special characteristics of students, the learning environment, and the course content are also considered when developing the model. The underlying theories of this research are the socio-constructivist and socio-cultural theories of learning (Lave & Wenger 1991; Vygotski 1978; Wells & Claxton 2002), which indicate that learning is related to all the actions that take into account a person as a whole.

In the FTL model (Keskitalo et al. 2010), facilitating is viewed as the facilitators' intentional activities to plan, guide, and evaluate students' learning processes (Kansanen et al. 2000) as well as to reflect on the facilitation itself. The introduction and simulator briefing phases of the Learning through Simulation model are considered more as facilitator activities. Students' activity, in the FTL model, which is considered as training, takes place mainly in the scenario phase, when students take part in the exercise. In the research literature, the term 'training' is often used without it being explicitly defined (cf. Glavin 2011). However, training is usually understood as training in procedural knowledge and skills to become something. As Gaba (2011, p. 9) points out "training refers to learning the actual elements of performance at some meaningful undertaking." The actual elements of performance can include learning — implicitly or explicitly — the values and other components of knowledge as well (e.g. declarative knowledge) (cf. Glavin 2011). In this present study, students' activity involves training to master the specific skills and knowledge needed in the field of healthcare within this specific learning environment. Therefore, student activities are referred to as training instead of studying (cf. Kansanen et al. 2000; Uljens 1997). In the FTL model, training is described through fourteen characteristics of meaningful learning (cf. Hakkarainen 2007; Jonassen 1995; Löfström & Nevgi 2007; Ruokamo & Pohjolainen 2000). The paper argues that the meaningful learning of students in SBLEs can be fostered by emphasizing the following characteristics: 1) experiential, 2) experimental, 3) emotional, 4) socio-constructive, 5) collaborative, 6) active, 7) responsible, 8) reflective, 9) critical, 10) competence-based, 11) contextual, 12) goal-oriented, 13) self-directed, and 14) individual. As the FTL model implies, learning is expected to take place in the debriefing phase because of student activities and their reflection on those actions (cf. Dieckmann2009). The model also implies that during the scenarios and debriefings, facilitators are occupied with guiding students' activities and reflection. The characteristics of meaningful learning and ways in which they can be facilitated in SBLEs are presented below (Table 1).

Table 1. Training characteristics and their applications

Characteristics	How it can be facilitated in SBLE?
1. Experiential and 2. Experimental Using prior experiences as a starting point for learning (Kolb 1984); experimentation with new tools, devices, situations, roles etc. (Gaba 2004; Cleave-Hogg & Morgan 2002).	The *environment* and *tasks* make possible students` active examination and experimentation. The *Facilitator* takes into account the students 'prior experiences' and actively encourages them to use them in learning and in responding to opportunities to gain new ones. *Students* utilize, reflect on, and accommodate prior experiences and acquire new ones.
3. Emotional The emotions are always intertwined with learning (Engeström 1982; Schuzt & DeCuir 2002); Taking into account emotions during the learning process.	*The Environment*, *the scenarios* and *the materials* are built to generate emotions (DeMaria et al. 2010). The *Facilitator* takes into account these emotions e.g. during the debriefing. *Students* reflect on their feelings and consider their influence to the motivation, activity, work etc. (Dieckmann et al. 2007.)
4. Socio-constructive and 5. Collaborative Students evaluate and accommodate new ideas on the basis of their previous knowledge; participating in the joint learning process (Jonassen 1995; Löfström & Nevgi 2007; Dieckmann et al. 2007).	The *Environment*, the *tasks,* and the *materials* support students` knowledge construction and collaboration. The environment could include tools where knowledge could be retrieved or stored for later use. The *Facilitator* develops tasks that are based on students' prior knowledge, conceptions, and beliefs and that require collaborative activity. He/she also guides these collaborative activities and knowledge construction. The *Student* participates in the interaction bringing his/her knowledge, understanding, and skills to the joint activity and discussion. She/he applies and practices knowledge and skills using different senses, learning strategies, roles etc. (Merriënboer & Sweller 2010; Tynjälä 1999.)

6. Active and 7. Responsible The student role is active and students are responsible for learning. The facilitator guides rather than lectures (Jonassen 1995; Fanning & Gaba 2007; Issenberg et al. 2005; Jonassen 2002).	The *environment* supports student activity. In addition, *the assignments* and *the learning materials* support students' active information retrieval, evaluation, and construction. The *facilitator* plans the meaningful learning activities and encourages students to apply their knowledge and practice skills during the learning process. The *students* are active and responsible in practicing, retrieval, evaluation, and application of knowledge as well as in discussion and reflection.
8. Reflective and 9. Critical Critical reflection of one`s own learning, learning strategies, knowledge, skills, attitudes, and the learning environment (Hakkarainen 2007; Jonassen 1995; Issenberg et al 2005; Rudolph et al. 2007).	The *environment* includes things that support student reflection (e.g. video camera, TV, peaceful and pleasant room, competent instructor etc.). In addition, the different kinds of *assignments* (e.g. learning diary) may support student reflection. The *facilitator* supports student reflection by asking questions, specifying, elaborating, guiding etc. The *students* reflect on their own learning processes and the decision making that was entailed in the processes (Dreifuerst 2012; Rudolph et al. 2007). Students receive and give feedback (Jonassen 1995).
10. Competence-based and 11. Contextual Training is based on the learning objectives; learning is contextual, thus learning objectives are simulated through real-life cases and examples (Hakkarainen 2007; Jonassen 1995; Löfström & Nevgi 2007; Ruokamo & Pohjolainen 2000).	The *environment* includes authentic tools and devices, which are embedded into real-life cases. Content is simulated through real-life cases as well as presented in a variety of ways and from different perspectives. In addition, the *learning objectives* are based on real-life competencies. The *facilitator* plans scenarios that are as authentic as possible and formulates the learning objectives, together with the students, if possible. This engages them better in learning and makes them conscious of the competencies they will need to have in the future (Schuzt & DeCuir 2002; Gibbons et al. 1980).The *students* try to figure out the solutions and different perspectives to the issues and compare the learning situations to the real world (Schuzt & DeCuir 2002;Tynjälä 1999).
12. Goal-oriented and 13. Self-directed Setting one's own learning goals and following up on those goals during the learning process (Brockett & Hiemstra 1991; Jonassen 1995; O`Shea 2003; Schuzt & DeCuir 2002).	The *environment, the assignments,* and *the materials* support the planning, follow-up, and evaluation of students` own learning. In the SBLE, the video recordings, learning diaries, observational ratings, tests etc. can be used to evaluate learning. The *facilitator* supports, guides, and maintains students` learning processes. The facilitator model, encourages and gives timely support. The *student*s set their own learning goals and actively try to fulfill them.
14. Individual Learning is individually different (De Corte 1995); Taking into account individual differences; providing individual guidance and feedback (McGaghie et al. 2010; Hakkarainen 2007; Ruokamo & Pohjolainen 2000; Zigmont et al. 2011).	The *Environment, the assignments,* and *the materials* support different learning styles. The environment could be revised for different needs. The *facilitators* familiarize themselves with the students and give individual feedback and support. The *students* can practice using the strategies that are suited for them and receive individual feedback from and about one`s own learning.

As noted, meaningful learning is constructed from a variety of things. However, it should be noted that not all of these characteristics have to be present all of the time in order for meaningful learning to occur. In addition, some of these characteristics overlap and interconnect (Jonassen 1995). These particular characteristics were chosen because they can be used as a practical aid for healthcare educators to plan, organize, and evaluate learning processes in SBLEs. With these theoretical viewpoints in mind, the facilitator could plan, implement, and evaluate the entire instructional process. However, the FTL model is not a strict model; it can be applied and modified. It is after all the individual participants' decision to state whether or not the experience has been meaningful to them.

RESEARCH QUESTION AND METHODS

The overall aim of this research is to develop a pedagogical model for SBLEs in healthcare education utilizing the principles of the DBR method. The purpose of DBR is to test and refine educational practice as well as theory by researching activities in authentic settings in collaboration with practitioners (Collins et al. 2004). The DBR method is based on continuous cycles of design, enactment, analysis, and redesign (Brown 1992; Collins et al. 2004; Design-based Research Collective 2003). This research is our second phase of DBR, although it is more of an application of DBR. First, a teaching experiment was carried out in Finland in spring 2009 (see Keskitalo et al. 2010). During this study, researchers observed the courses designed by facilitators because of the time constraints; therefore, the enactment phase of the pedagogical model was omitted. The present research is best described as a qualitative case study. Data was collected and then analyzed, taking into account the principles of the FTL model. The following research question guided the work: *From facilitators' and students' perspectives, how does the facilitating and training in SBLEs foster the meaningful learning of students?*

Data Collection and Analysis

Empirical data was collected in two different simulation centers at Stanford University (Palo Alto, CA, USA) between February and March 2010 using various methods (see Table 2). Students (*n* = 25) were mainly second year anesthesia residents and third- and fourth-year medical students, whereas the facilitators' (*n* = 9) specialties were anesthesia, surgery, and nursing. The students were studying anesthesia crisis resource management, emergency medicine, and anesthesia clerkship. The youngest respondent was 26 years old and the oldest was 38 years old. Most of the students had no prior experience of simulation (20 %) or they had been exposed to no more than two simulation-based courses (64 %). Altogether, the data was collected from five different courses, which lasted from three to nine hours. During the courses, all the activities were prepared by the facilitators and carried out in group format. During the scenarios, there was usually one student who had a leading role (the "hot seat" person) and who could call on others to help. Those students who were not taking part in that scenario watched the scenario from a separate room via television. The structure of the course followed the Learning through Simulation Model (Joyce et al. 2002). Before the study, research permission was applied for and approved by the institutional review board, and thereafter, consent was obtained from the participants were the purpose and aims of the study was explained. The participants were also informed that they would not receive any compensation for taking part in this study. It was also emphasized that participation is voluntary and they could withdraw from the study at any time. However, all the participants decided to take part. This article includes analyses of 1) group interviews and one individual interview, 2) video recordings, and 3) field notes, briefly introduced in Table 2.

Table 2. Data collection and analysis methods as well as data sources

Data Collection Method	Data Source	Data Analysis Method
Group Interviews, one individual interview	Facilitators (*n* = 9), Students (*n* = 16) 2 Anesthesia Crisis Resource Management II courses, 2 Emergency Medicine courses, 1 Anesthesia clerkship	Atlas.ti qualitative coding and analysis software Qualitative content analysis
Video Recordings	Facilitators (*n* = 6), Students (*n* = 16) 2 Anesthesia Crisis Resource Management II courses, 1 Emergency Medicine course	Qualitative content analysis
Field notes	Facilitators (*n* = 9), Students (*n* = 25) 2 Anesthesia Crisis Resource Management II courses, 2 Emergency Medicine courses, 1 Anesthesia clerkship	Qualitative content analysis

1) The semi-structured group interviews were first outlined, tested by the students, and then edited by the authors. These test interviews are not included in this research. The first two authors carried out and voice recorded the actual group interviews after the simulation activities in February and March 2010. The first author interviewed the students while the second author was interviewing the facilitators. There were four facilitator group interviews (facilitators were interviewed in pairs), one facilitator individual interview, and three student group interviews. Each of the interviews lasted approximately thirty minutes. The time constraint was due to the long days and the shortage

of time, as participants needed to attend to other obligations. This was also a contributing factor in considering the group interview as the appropriate data collection method. Facilitators and students were asked questions related to concepts of teaching and learning (e.g. How do you think people learn? Describe learning as you understand it), the course structure (e.g. How do you think facilitation and training should proceed in simulation-based learning environments?) and the characteristics of meaningful learning. For example, the goal-oriented characteristic of meaningful learning was elaborated by asking questions such as, Were you aware of the learning objectives of the course? How do you think the teaching aimed to achieve those objectives? The interviewers also probed or asked the participants to specify if something was unclear to them. A transcription service transcribed these group interviews verbatim.

2) In three of the courses, the scenarios and debriefings in the simulation centers were recorded on video. The scenarios ranged in length from nine to thirty-eight minutes, whereas the debriefings varied from six to fifty-one minutes. The average duration of the scenarios was 24 minutes, and for debriefings it was 26 minutes.

3) The first two authors of this article carried out observations and made paper-and-pencil field notes during all the simulation activities, including the introduction, simulator briefing, scenarios, and debriefings. These field notes included the dates and times of each course, participants and their roles, the start and end of each activity, and other important notes related mainly to simulation-based learning. The field notes were transcribed by the first author and together they consisted of 72 pages of transcribed field notes from five different courses.

The interviews and field notes were analyzed using the qualitative content analysis method, (Brenner et al. 1985; Cohen et al. 2011; Graneheim & Lundman 2004) and coded using the qualitative data analysis software Atlas.ti. Content analysis is usually understood as a systematic and an objective analysis of the visible and obvious components of the text (e.g. Gray 2004; Graneheim & Lundman, 2004). However, qualitative content analysis also makes judgments based on the latent content, that is, it makes interpretations about the underlying meaning of the text (Graneheim & Lundman, 2004). Therefore, it is considered very suitable for exploring such a multifaceted phenomenon as learning.

In the beginning of the analysis process, the transcriptions of the interviews and field notes were read twice in order to obtain an overall picture of the phenomenon. In the second phase, in order to capture the meaningful learning process, the transcriptions were read again, and significant sentences from the data and coding were underlined with Atlas.ti with respect to the research question. Cohen et al. (2011) stated that coding is a central process in qualitative analysis as it enables the researcher to identify similar information from text-based data. Codes simply contain an idea or a piece of information. In the analysis of the interviews and field notes, the unit of analysis was an utterance or the note made by the researcher that reflected the research questions in some way that is meaningful learning. This first coding produced 214 different codes. In a third phase, the categories were created from codes that had the same meaning. In this phase, the categories were also compared to the theory to identify differences and similarities. The transcriptions of interviews and field notes were also re-read if the meaning of the code was not clear or if there was uncertainty about the naming of the category. After the second coding, there were 32 different categories. In this phase, the training characteristics were chosen to comprise the main categories of this study, which decreased the number of categories to 14. The omitted categories dealt with the conceptions of teaching and learning and they will be the subject of a different article. In the final phase, the fourteen categories were connected as presented in the introduction, and final themes were created based on the research question and coding process. In this phase, the video recordings were used as a supplementary information source. The video recordings were viewed and compared to theory-driven categories and themes in order to see if they also supported the categorization and thematization made based on the textual data. Those characteristics that were supported received more favorable quotations than those that were only somewhat supported. All in all, the analysis was an iterative process, and finally the data was classified into the theory-driven categories and themes (Flick 1998). To enhance the trustworthiness of the study, the second author also performed a separate analysis (Graneheim & Lundman 2004; Lincoln & Cuba 1985). The second author went through the data and categorization assigned by the first author. Thereafter, the authors discussed the differences in their categorization, and came to a joint decision about them. As noted, they arrived at the results together.

RESULTS

The data analyses indicate that learning in SBLEs fosters the meaningful learning of students quite extensively. The training characteristics that were supported were *experimental, experiential, emotional, socio-constructive, collaborative, active, responsible, reflective, critical, competence-based,* and *contextual. Goal-oriented, self-directed,* and *individual* characteristics were only somewhat supported. Table 3 presents the final themes and the excerpts.

Table 3. Themes and excerpts from the interview data.

Training characteristics and examples from the data	Themes
EXPERIENTIAL AND EXPERIMENTAL: "So it gives them a chance to really be a doctor, I guess." (Group interview 1, facilitators) "But when you`re in a stressful situation, I think the things that come back to you the best are the things that you`ve actually seen in real life with a patient." (Group interview 2, students)	***PRIOR EXPERIENCES AS STARTING POINT FOR EXPERIMENTATION OF REAL-LIFE CASES:*** *Experimentation of different roles, situations, devices, alternatives etc. Utilizing the prior experiences as a starting point for learning.*
EMOTIONAL: "…many of the scenarios are intended to generate emotional responses." (Group interview 4, facilitators) "I think it always triggers a little bit of doubt; a little bit of well, if this happens in the real world, am I going to be able to (remember what) happened here. I think that it may challenge you to remember that all the little facts that you do have to remember may actually apply someday. And you have to be able recall those pretty quickly. On your own. Without the help of a friend. No multiple choice." (Group interview 1, students)	***STUDENTS EXPERIENCE THE WHOLE GAMUT OF EMOTION:*** *Facilitators create while students experience the whole variety of emotions. Students' emotions are taking into account especially in scenarios and debriefings.*
SOCIO-CONSTRUCTIVE AND COLLABORATIVE: "Well, I guess what we do is we do expect people who`ve been exposed to certain subject matter concepts to try to build on what they know." (Interview, facilitator) "I think the fact that we know each other all pretty well, and we worked with each other in the last year and a half really helps. And I think for the most part, our personalities in the group, we mesh pretty easily and we all have each other's best interest at heart in order to basically help each other out during these cases. So, I thought it wasn't hard to work with each other in these circumstances. They're quite helpful, you know you can count on these guys and they'll be there to help you out." (Group interview 1, students)	***PREVIOUS KNOWLEDGE AND SKILLS AS A STARTING POINT IN COLLABORATIVE LEARNING:*** *Students construct more accurate knowledge structures based on their prior knowledge, concepts, and beliefs using different senses and learning styles. SBLE is designed to be a collaborative undertaking.*
ACTIVE AND RESPONSIBLE: "…it's just more of an active learning experience; you learn by your own reaction to the situation, as well as what people are saying to you" (Group interview 2, students) "…it's unique; it compared to lectures and other passive learning, it's active and experiential." (Group interview 4, facilitators)	***STUDENTS`ACTIVE ROLES AND ACCEPTING THE ROLE OF RESPONSIBLE PROFESSIONAL:*** *Students' roles are active in scenarios and debriefings. They apply what they have learned so far and engage in discussion. They also apply the role of the professional, which is highly responsible.*

REFLECTIVE AND CRITICAL: "And then we hope when we talk in the debriefing to kind of figure out what do they do, why do they do it, and where are the gaps. And I think that's the bit -- we kind of have the background from the simulation and then we try to look for the gaps, and either have the participant self-learn by exposing those gaps or try and fill those gaps in some way." (Group interview 3, facilitators) "The point of this isn't really to learn fast or memorize things or do that kind of first stage of information gathering. It's more of a how to use that knowledge in a situation. More of like a teaching judgment. I guess just kind of keeping your head in a crisis sort of ideas. So, it is much different than what our classic education is [Interposing]. I think as we get on to their teaching us less and less facts and more and more judgment and decision making ability." (Group interview 1, students)	***"DEBRIEFINGS ARE INTENDED TO SUPPORT REFLECTION" AND CRITICAL THINKING OVER THEIR OWN LEARNING:*** *Reflection about the experience and exposing the knowledge gaps in a safe setting. Maintaining student-led discussion and critical thinking.*
COMPETENCE-BASED AND CONTEXTUAL: "And professionalism; how they interact with their colleagues." (Group interview 4, facilitators) "S3: I think it sticks in your memory better. And it stresses things that are hard to teach like communication skills and -- S2: Logistics of [Interposing] things happen in the OR." (Group interview 1, students)	***ACQUIRING DIVERSE COMPETENCIES IN REAL-LIKE SITUATIONS:*** *Acquiring declarative and procedural knowledge as well as skills and professional attitudes in real-like settings.*
GOAL-ORIENTED AND SELF-DIRECTED: "Not officially. We don`t give them the opportunity officially. They may do that on their own. And some maybe they do, some I`m not sure." (Group interview 3, facilitators) "Actively finding out what where your weaknesses are what you're unsure of. Being able to take what you think you know, but see if it actually works." (Group interview 2, students)	***INFREQUENT SETTING OF THE INDIVIDUALIZED LEARNING GOALS WHEREAS SELF-DIRECTEDNESS WAS SUPPORTED MAINLY IN DEBRIEFINGS:*** *Articulation and setting of the learning goals where ambiguous and students rarely set any of their own learning goals. Their interested was mainly in attaining and evaluating the general learning goals.*
INDIVIDUAL: "We allow individual questions to be answered, but that's about it." (Group interview 5, facilitators) "I think they just treated us all the same, basically." (Group interview 2, students)	***INDIVIDUALIZED FEEDBACK IN DEBRIEFINGS:*** *Students' individuality is mainly concerned within group settings in debriefings.*

As the following theme suggests *Prior experiences as a starting point for experimentation of real-life cases*, the experimental and experiential characteristics were supported, mostly in the planning of the course and during the scenarios phase. Facilitators typically planned the course based on adult learning theories and theories of experiential learning such as Kolb's (1984) experiential learning theory. What motivated the facilitators most was the desire for student engagement in learning and to identify effective ways to foster that engagement. That is why they considered and delved into the above-mentioned theories. Before the courses started, the facilitators also considered the students' general experience levels, but not the individual student's experience level or what kind of clinical experiences they have had. During the scenarios, students could try out different kind of devices and situations, and most importantly, could be the primary decision maker in that situation. Students also mentioned that because medicine is a very experience-based field, they had to use their prior experiences in learning. In the debriefings, students as well as facilitators could also share their experiences.

Emotionality was also strongly supported as the theme *Students experience the whole gamut of emotions* indicates. Students' emotions varied from surprise and engagement to stress and frustration. According to the students, emotions arose particularly during the scenarios, when the cases were challenging, and when they had to be in front of others or had difficulties performing the procedure with the simulator. The intention of the facilitators was not only to generate emotions, but also to take those emotions into account, especially in the debriefings. According to the students, the facilitators were empathetic and cautious and gave positive feedback. During the introductory phase, the facilitators also tried to concentrate on team building and creating a positive atmosphere among the students. One of the participants mentioned that they tried to use the mannequin and the scenarios in a somewhat humorous fashion to decrease the anxiety among the students. Regarding engagement and motivation, it was also important to tell the students why they were there. According to the facilitators, it was important to state why this particular exercise was important to them, and as one of the facilitators stated, "showing them what the alternatives to not knowing are."

Realization of the socio-constructive and collaborative characteristics is best described in the theme *Previous knowledge and skills as a starting point in collaborative learning*. Facilitators planned the courses based on students' prior knowledge, and while training, students were expected to apply their knowledge and skills. The whole course was designed to be a collaborative undertaking. Among the students, collaboration occurred in the exchange of information, and in helping and encouraging each other. In some of the courses, the lectures were given before the scenarios, which supported the socio-constructive characteristics. This gave students the opportunity to evaluate and accommodate new ideas based on their previous knowledge structures. The SBLEs supported the students' involvement and responsibility in their learning as the theme *Students' active role and accepting the role of responsible professional* signifies. The students were active, especially in scenarios and debriefings when figuring out the diagnosis and treatment, performing activities related to the case, and analyzing the situations. They also consider themselves as professionals, who are responsible for their own actions and learning. Facilitators supported the students' activities by giving hints and trying to guide student-led discussions during the debriefings. However, they mentioned that this is kind of an idealized goal, which could rarely be realized. In particular, inexperienced students expected more direct guidance during the debriefing sessions.

In SBLEs, the debriefings were designed to engage students in reflective and critical learning as the theme *Debriefings are intended to support reflection and critical thinking over their own learning* suggests. During the debriefings, students reflected on the experience and tried to expose any knowledge gaps and form new learning objectives with the help of the facilitator and their peers. In the debriefings, students discussed the cases they were treating, what was done well, or what went wrong, what could have been alternative solutions, and the effectiveness of the communication. In these situations, students also discussed their emotions. Facilitators mentioned that this was also the phase were they thought most about how the learning occurs. In these courses, debriefing varied from six to fifty-one minutes. The facilitators' different levels of experience as simulation educators might have been a reason for the differences in debriefing times.

As the theme *Acquiring diverse competencies in real-life situations* indicates, the competence-based and contextual training characteristics were supported. When planning the scenarios, facilitators tried to make them as "realistic and relevant" as possible, and at the same time, to keep the learning objectives in mind. Facilitators mentioned several competencies that students should gain during the course, including basic medical knowledge, the principles of crisis resources management, and interpersonal skills. These were usually presented in the introduction. Although the students appreciated the reality of the scenarios, they also thought that they were somewhat unrealistic at times. Unreality came up when discussing communication and performing the procedures with the simulator.

Goal-oriented and self-directed characteristics were only slightly supported in these courses as the theme *Infrequent setting of the individualized learning goals* whereas *self-directedness was supported mainly in debriefings* presupposes. The facilitators mentioned that formal articulation of the learning goals was rather weak and only one of the facilitators said that the students set their own goals in addition to the general learning goals. Others stated that they assumed that students set their own learning goals, but they did not question them regarding whether they had done so. When asked about the individual learning goals, only a few students had set their own learning goals; they were quite general in nature, such as don't kill the patient. Therefore, the interest was mainly in attaining and evaluating the general learning goals in debriefings. Students also mentioned that goals for the simulations were poorly articulated and that they did not know what to expect, and this had prevented them from setting their own learning goals.

As the theme *Individualized feedback in debriefings* indicates, the debriefing session was the place where students had an opportunity to receive individual feedback and guidance. As the facilitators mentioned, they directed their questions mostly to the person who had been in the "hot seat", although they also mentioned that they made special efforts to draw out quiet participants and allowed individual questions to be answered. Facilitators mostly considered students' individuality before the exercises, and when taking into account their experience levels. However, according to the facilitators, they only knew the general levels of the students, but not the students' individual experiences and knowledge base such as what kind of clinical experience each student had.

DISCUSSION AND CONCLUDING REMARKS

The aim of this article has been to evaluate the meaningfulness of five different simulation-based courses based on the authors' previously developed pedagogical model, and especially on the characteristics of meaningful learning. The results of this study indicate that simulation-based learning can be considered quite meaningful (cf. Keskitalo et al. 2010), although the facilitators were not instructed to follow a certain model. It seems that simulation-based learning is, at its foundation, meaningful since it inherently supports the many characteristics of meaningful learning. Simulation-based learning is designed to be a collaborative, active, experiential, and reflective undertaking. In the course of that experience, students may also live through various emotions and real-life situations, which are immediately transferable to their everyday practice and can enhance their future performance (cf. DeMaria et al. 2010; Paskins & Peile 2010). Although more realism does not necessarily guarantee better learning outcomes (Dieckmann et al. 2007), a certain level of realism is necessary for students to learn (Alinier 2011). Many of the characteristics are also congruent with the features and uses of high-fidelity medical simulations that will lead to effective learning (Issenberg et al. 2005). However, simulation-based learning does not inherently support all characteristics. In this study, the *goal-oriented*, *self-directed,* and *individual* training characteristics were somewhat supported during the facilitation and training in SBLEs; this was a drawback or limitation of simulation-based education found also in previous studies (Keskitalo et al. 2010).

The results have several implications. In the future, when running courses and redesigning the model, educators should address the goal-oriented, self-directed, and individual characteristics of meaningful learning. The goals direct our thoughts, behavior, and strategies; (Schuzt & DeCuir 2002) therefore, they are also important determinants of learning and should be clearly stated (Biggs 1996). As mentioned earlier, setting the goals means both setting the individualized goals and the general learning objectives (Hakkarainen 2007; Jonassen 1995; Löfström & Nevgi 2007; Ruokamo & Pohjolainen 2000). In their meta-analysis, Issenberg et al. (2005) concluded that defined outcomes are the one core feature of the use of high-fidelity medical simulation that will lead to effective learning. Thus, facilitators should select their teaching methods based on the goals and desired levels of understanding. Besides setting the goals, they should be followed and evaluated (Biggs 1996). As Gibbons et al. (1980) have stated, self-directed learning may in the long run be more important to the development of expertise than formal education (p. 42). In this task, facilitators might have helped students to follow and evaluate their learning, for example, in debriefings, but individualized counseling sessions might also have been helpful. Facilitators should also adopt assessment methods that are in line with the educational principles and learning objectives (Biggs 1996). Learning is also inherently individual (De Corte 1995), prompting the authors suggest that special attention should be paid to students' individuality, since there may be students who expect individualized guidance and feedback (Keskitalo et al. 2010).

The utilization of the DBR method also has implications for theory (Barab & Squire 2004). There are many characteristics that are overlapping; therefore, future research should concentrate on detecting the most important characteristics for enhancing students' meaningful learning, and study them in depth to provide clearer examples to help facilitators make their teaching decisions (Biggs 1996). It would be also interesting to find out if facilitators emphasize and prefer different characteristics than students. Although the FTL model provides a rather general picture of meaningful simulation-based learning it was important to conduct this research to see how learning occurs in these environments (Barab & Squire 2004). This helps us to develop the FTL model and guide instructional processes in SBLEs, since currently it is not well-known when and how simulation-based education should be applied (Cook et al. 2011; Helle & Säljö 2012).

The study has limitations, which should be considered when interpreting and implementing the results. Firstly, the interviews were quite superficial, since they were conducted in groups and lasted an average thirty minutes. Therefore, there is uncertainty regarding what individual students might have thought about certain things. It is also possible that the participants interpreted questions differently than the researchers had anticipated; therefore, the participants may have provided answers to slightly different issues. Since the researchers were interviewing English-speaking participants, as English was not the interviewers' native language.

Kember (1997) also notes that, although researchers categorize data based on the interviews and the wording of interviewees' responses, the interviewees themselves do not necessarily pay much attention to the words that they use. As noted, self-reporting is one potential data-collection method, but it may not necessarily be the most appropriate. In addition, it would have been beneficial to link the video recordings to our interviews in order to elicit deeper discussion about the participants' performance and learning experience. Secondly, the participants were all volunteers; therefore, the researchers might have collected the data from outstandingly motivated medical educators and students. However, it is always possible that simulation educators and researchers might confront students that are not so willing to act in a situation or reflect and expose their knowledge gaps during the debriefings and interviews. It is also possible that students may have wanted to appeal to the researchers and facilitators and gave answers in the interviews that they think they would like to hear. In this study, however, the field notes and video recordings supported the analysis of the group interviews.

Thirdly, there were some time constraints and the researchers were limited in their ability to follow the principles of the DBR method exactly, which should be taken into account when redesigning and interpreting the FTL model. The researchers were willing to follow the DBR method, but the schedules were so tight that the co-designing sessions and implementation of the model into practice were abandoned. Testing of the model would have also required the facilitators to modify courses that were part of the curriculums so it would have required some extra work from them. Instead, it was decided that the courses were evaluated based on the model and after the data analysis the suggestions for further development of the model and practice were given. The facilitators were familiar with the model in general as it was presented to them before the courses; however, it should be borne in mind that the practical testing of the FTL model was inadequate. Fourthly, with these data collection methods we are unable to show if, or what, students had learnt during these courses. Therefore, further studies should include pre and post-test to measure students' learning gains. Fifthly, we collected data only from medical students and residents so further studies are needed to confirm our findings in wider student populations. For instance, to investigate if there are differences within the medical students and junior physicians in their experiences of simulation-based learning. As Walton et al. (2011) identified, at that beginning nursing students enter the simulation-based learning environment feeling insecure, uncomfortable and anxious, but repetition and more exposure to simulation-based education increased their self-confidence and professionalism.

In summary, this study has provided diverse perspectives on how to plan, implement, and evaluate meaningful simulation-based learning; this is particularly valuable for healthcare teachers, teacher educators, instructor trainers, designers, and researchers. However, the limitations of the studies should be taken into account when interpreting the results. Although simulation-based learning can be considered inherently meaningful, inexperienced and beginner medical educators might benefit from practical examples of how to plan simulation-based learning in a pedagogically appropriate way. Therefore, the FTL model provides a framework for the factors that should be taken into account when the meaningful learning experience of the students is the primary goal of simulation-based medical education.

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Practice points:

- This study contributes to current research into simulation-based learning by providing insights into students` meaningful learning in SBLE.
- It seems that simulation-based learning is, at its foundation, meaningful.
- Goal-oriented, self-directed, and individual characteristics need to be emphasized.
- Future research is needed to explore the most important characteristics of meaningful learning in SBLE.

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