ILME

DEVELOPING SIMULATION PEDAGOGY

for Nursing Education in a European Network

Eds. Esa Poikela & Outi Tieranta

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Learning by Simulating

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According to a 30-year-old model of good learning and teaching, the student must be oriented and motivated toward the subject matter in the first stage of learning. Then, as early as in the second stage, the student should be guided to perform concrete activities connected to the goals of the learning process. Action—in other words, the physical stage of learning—should thus start immediately after forming the basis for learning through orientation. In the third stage, the subject matter should be brought under verbal treatment, in which the students discuss it using the concepts that are essential for understanding the matter at hand. During discussion, the subject matter targeted for learning is internalized to such an extent that the students are able to move on to the fourth thinking stage, where they can perform independent deduction concerning the subject matter and their own activity with regard to the assignment. The fifth and final phase is automation, whereby the subject matter has been understood and practiced so thoroughly that the learners can recite it off by heart. (Galperin, 1979; Poikela, E., 2010.)

The most significant insight gained from this model concerned the impossibility of omitting even a single phase without learning results being negatively affected. With such omissions, the construction of learning and skill will simply remain unfinished. Sometimes teaching stops at the first phase of the model, and moving on with the stages of learning is left to the learner's devices alone. Vocational training should reach the level of action at the very least, but not at the expense of acquiring knowledge, as is sometimes the case. Based on this model, the real challenge for development is encountered in the stages of *action and verbal* treatment, where the student's *practical and epistemic* skills start to develop, and the desired expertise is attained.

All too often, learning is limited to passive receiving or the level of *learning by being*. *Learning by doing* is reached when the aim is the acquisition of defined, concrete skills. The skills of verbal analysis and thinking, on the other hand, require conversation, interaction, construction of shared and personal knowledge, and combining theory with practice. This integrative process can be characterized as *learning by making, developing, or creating*, which enables the production of expertise and professional development (Poikela, E., 2010 & 2012).

What about *learning by simulating*? Does it mean just learning by doing or is it more—creating, developing, or at least learning by making? In the age of industrialism, simulation pedagogy was seen as doing, chiefly as practicing physical skills. Nowadays, professionals need deeper, greater, and more abstract skills, e.g. for problem solving, decision making, knowledge acquisition, assessing, leading, etc. It is no longer useful to separate the processes of learning in classrooms from theory and practicing in workshops. At best, learning by simulating offers the possibility to develop practical and theoretical skills simultaneously for comprehensive action and the "knowing" of professionals (cf. Poikela, P., 2012).

The International Learning Modules for Nursing Education (ILME) project

Simulation-based education is a part of the pedagogical solutions in the health care profession. Simulations in nursing education are mainly focused on resuscitation and other acute situations. Simulation should be implemented in the entire nursing curriculum because of its broad benefits and possibilities. Although simulation can be an effective method on the road to learning the competences, it cannot replace a well-planned curriculum (Kerner, 2010, 142).

International Learning Modules for Nursing Education (ILME) is a European Social Fund (ESF)-funded project, which is a continuation of the simulation pedagogic development in Rovaniemi University of Applied Sciences (RAMK).

The ILME project aims to foster and develop cooperation in the European network. The project network partners work together with the overall objective of improving patient safety by using the means of simulation and virtual education, and by developing facilities to implement collaborative teaching and common practices. Another aim is to take the best practices from simulation education acknowledged in an earlier project called TOVI and put them into practice (Tieranta & Poikela, P., 2012). The project is financed by RAMK, in the hospital district of Helsinki and Uusimaa and by the Centre for Economic Development, Transport, and the Environment.

One of the ILME project outcomes was three learning modules for nursing education. The modules are adult nursing, mental health care and psychiatric nursing, and pediatric and adolescent nursing. Simulation pedagogy and virtual learning will be used in all these modules. To reap the advantages of simulation, it is important to recognize the different factors of simulations and their meaningful use in nursing education. Problem-based learning (PBL) as a learning method provides many opportunities to use simulations and it facilitates interaction between a student and a teacher.

The project modules and the simulations that are used in them can be utilized in nursing education in a European network. The modules will enhance staff and student mobility. However, despite the fact that the competence requirements for a general nurse in Europe are the same, one must not forget to pay attention to the different cultural features in each country. The project has been presented at various scientific conferences (Nurmi, Silvennoinen, Mattila, Rovamo & Rosenberg, 2013; Mattila, Silvennoinen & Nurmi, 2013; Tieranta, 2013a & 2013b; Vatanen, 2013a & 2013b; Törmänen, 2013).

The content of the book

Part I introduces the ILME modules and the integration of PBL and simulation (PBLS) into the nursing curriculum. There is an overview of how simulation is used in various ways in the PBL cycle. In the first article, Esa Poikela, Outi Tieranta, and Marko Vatanen describe how an adult nursing module pilot was run and how the model of PBLS was developed. In a mental health care and psychiatric nursing module, Paula Yliniemi and Leena Välimaa employ a simulation and virtual-based learning in a module. They highlight a new concept session and how it is defined as a method between a skill station and a full-scale simulation. The third ILME module is a case description by Arja Jääskeläinen and Tarja Pykäläinen about a pediatric and adolescent nursing module. The article presents a case on how simulation is integrated into an implementation plan.

Part II is about researching computer related simulations. Antti Pirhonen and Minna Silvennoinen present a case study for computer-assisted learning (CAL). The content of the educational game is perioperative nursing. Paula Poikela and Tuulikki Keskitalo have studied computer-based simulation for official communications.

Part III on training and assessment explores the learning outcomes of simulations among health care professionals. Hanne Selberg and

Mette Elisabeth Nielsen present the study of voluntary simulation workshops in nursing education. Eerika Rosqvist and Seppo Lauritsalo have measured the outcomes of multi-professional trauma teams after simulation training. Elisa Nurmi, Liisa Rovamo, Minna Silvennoinen, Minna-Maria Mattila, and Per Rosenberg's research focuses on simulation team training in neonatal medical emergencies.

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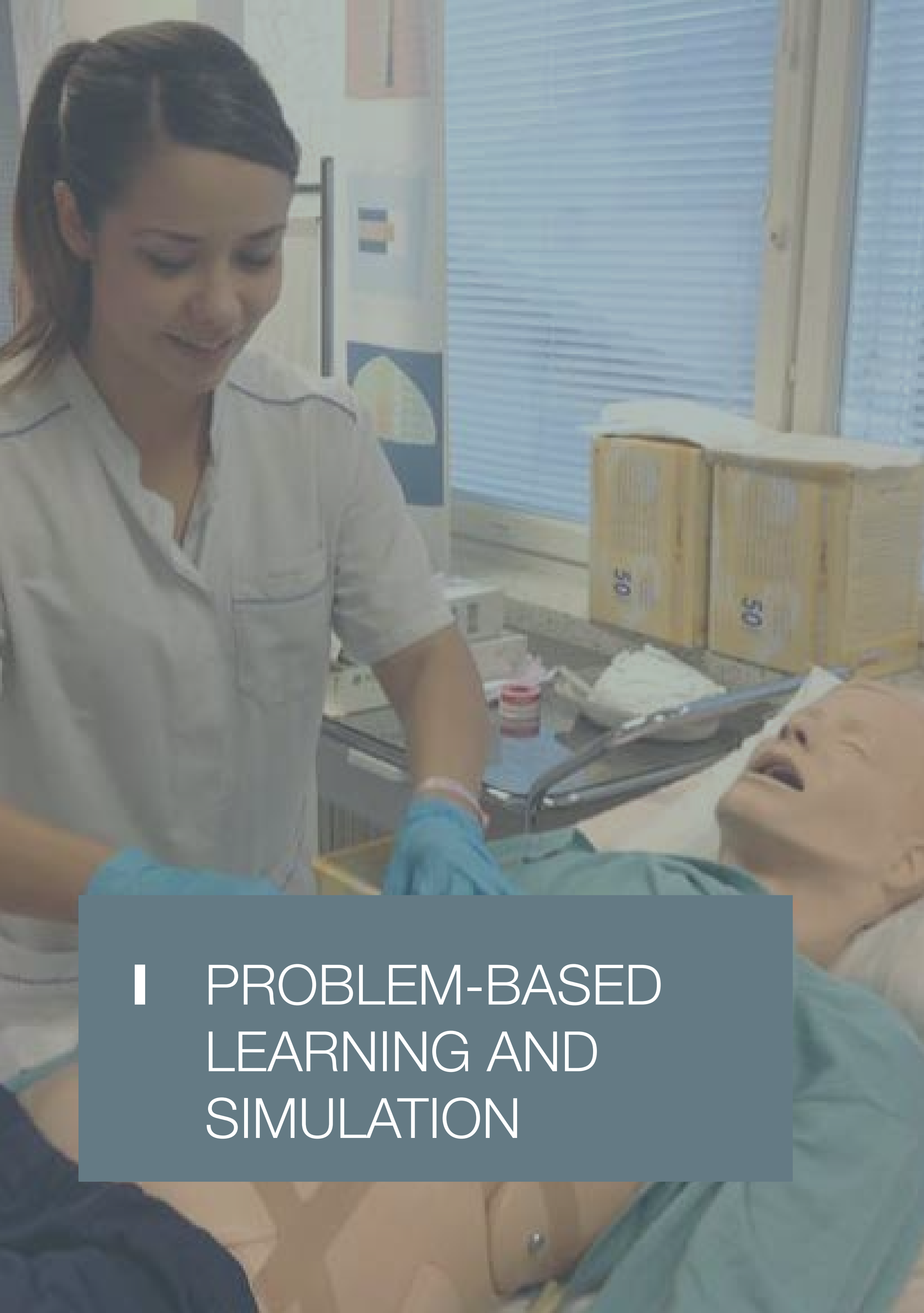

I PROBLEM-BASED LEARNING AND SIMULATION

When Simulation Meets the PBL Curriculum: a PBLS-Model from the ILME Project

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The complexity and continuous change in the modern world and society is challenging educational institutes to keep up with the change. The ever-growing amount of information also brings us to the deeply epistemological questions about knowledge, learning, and competence. The role of teaching is changing as well. It seems inevitable that Higher Educational Institutes (HEIs) have to react to this change by updating their approach to teaching, learning, and producing competences.

RAMK gained significant experience with simulation pedagogy during a previous project called TOVI (Use of Simulation Education and Environments in Ensuring Clinical Competence in Patient and Customer Safety). During the TOVI project, we benchmarked the best practices in simulation across Europe (see Poikela, E. & Poikela, P., 2012; Tieranta, O. & Poikela, P., 2012).

The ILME project is a continuum to develop simulation further as a learning method and to embed simulation into the curriculum more systematically than before. The principal objective for the ILME project was to use simulation in versatile ways to support learning in nursing education. During the project, three nursing modules were updated to meet up the objectives and one of them was piloted during spring 2013.

In this article, we will describe how different types of simulation can be utilized in a nursing module that is based on PBL. We will also describe how the ILME pilot was run and how simulation was applied into a PBL-based module. Various elements of the simulation process are implemented in the phases of the PBL cycle.

Problem-based curriculum and simulation pedagogy

RAMK is updating the whole curriculum to meet the challenges of the modern, rapidly changing world. RAMK's vision is to reshape its vision of learning methods in teaching and learning environments, and to adopt more effective practices for guiding the learning process (Study guide 2013-2014, 2013). The focus is now heavily on the experiential approach to learning and on close contact with real working life. The new curriculum is built around the principles of PBL. PBL can be described as a leap forward to a new epistemology where the common dualistic approach to knowledge (theory and practice) is replaced with a three-dimensional conception of knowledge; theory, practice, and experience (Poikela, E., 2005, 29–30; Poikela, E., 2012, 18–22; Oikarinen, 2013, 33). RAMK's new curriculum is based on the cyclical model of PBL, originally developed by the University of Linköping, Sweden. The cyclical model is widely used in medical and health care education.

The problem-based curriculum is organized around problems and problem themes (see Figure 1) that produce core skills (e.g. general professional skills), which means that the time, the place, and the situation-specific factors of problem solving are taken into consideration. After the adoption of PBL, the amount of contact teaching tends to decrease because students are encouraged to seek a large proportion of the knowledge that was previously given in lectures for themselves. The function of the curriculum is not merely to provide the operational setting for learners, but the physical, social, and virtual space in which all the factors that facilitate learning have been anticipated, defined, and planned as well as possible (Poikela, E., 2012).

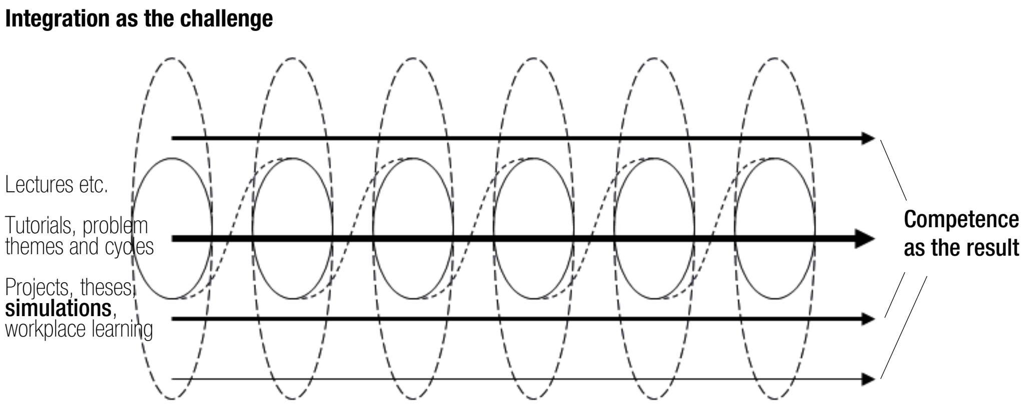

Figure 1. The process of the problem-based curriculum (see Poikela E., 2012, 26)

The tutorial is the dynamo of PBL: a group of 7–9 students who meet approximately once a week and are instructed by a tutor teacher. The problem theme is constructed out of a few problems and is carefully planned. The PBL cycle is the basic state of *epistemic* working, which teaches thinking, communication, and cooperation skills, and builds the identity of the professional. The simulation is one of the most important spaces where students can acquire *practical* knowledge and skills for their professional growth. They are also, in the best scenario, able to have experiences of work life.

One of the challenges in the process of curriculum updating is that PBL has a fundamentally different approach to learning and teaching as well. The main emphasis is on problem-solving skills, knowledge acquisition, and collaborative working. Traditionally, we have focused more on technical skills and the theoretical subject questions. However, it is impossible to involve all the aspects of the traditional curriculum in certain problem-solving themes. Thus, the independent part of studying becomes more important than before: Are we able to provide students with a versatile and motivating learning environment and to support their knowledge acquisition in inspiring ways?

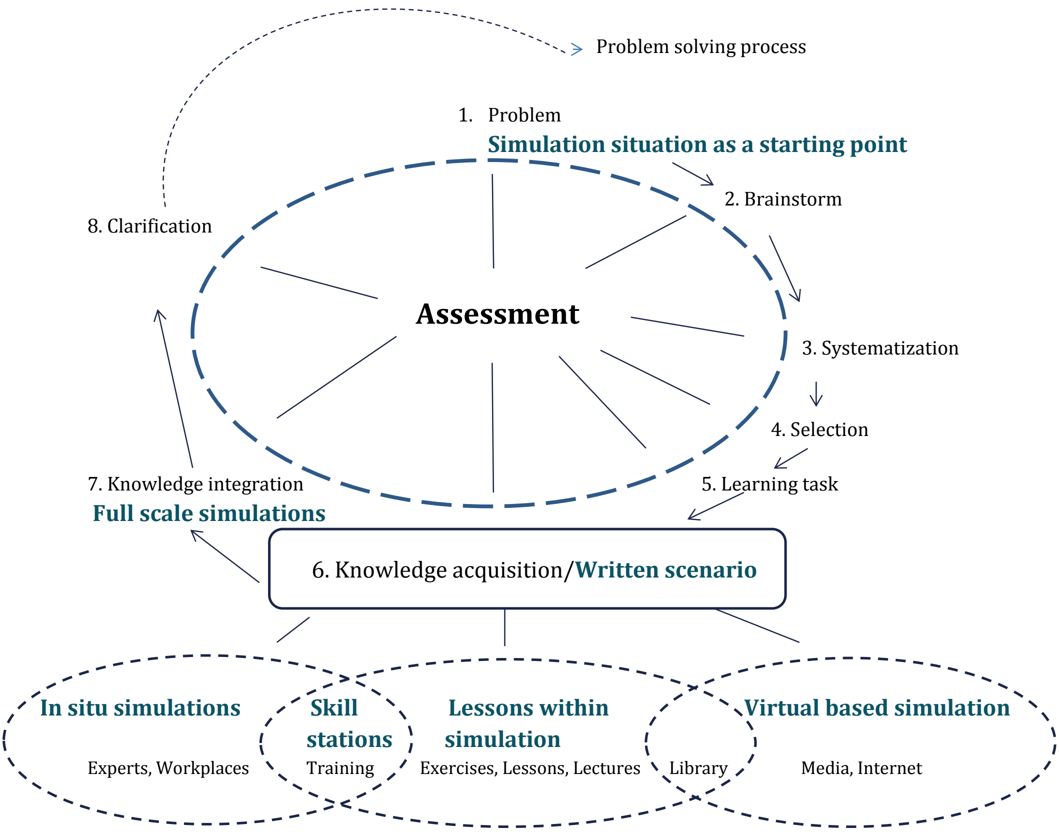

Figure 2. Problem-Based Learning and Simulations, PBLS model (cf. Poikela, E. & Poikela, S., 2005; 2006, 78; Oikarinen, 2013, 29)

Simulation situation as a starting point in the PBL cycle

The starting point of PBL is the problem, and the construction of knowledge is based on the cycle of the problem-solving process. Thus, understanding the importance of the problem is the key to building a successful learning opportunity for students. A simulation situation as a problem brings students to the heart of actual working life (see Figure 2).

The aim of this pilot was to use simulation in different phases of a problem-solving cycle. The blue text in Figure 2 indicates the implementation of the simulation during the problem-solving cycle. Fifty-seven second-year students participated in this pilot module and six of them were international students. The nursing module consisted of five problem cycles and practice—a total of 15 ECTS (European Credit Transfer and Accumulation System). Three learning cycles were built around a medical nursing theme and two cycles around a surgical nursing theme. For practical reasons, students were divided into two main groups. One half started with medical nursing themes and the other pursued surgical nursing themes. Two main groups were both further divided into three different tutorial groups, so the average tutorial group consisted of ten students. Six tutors (lecturers) ran the tutorials.

When using the simulation as a starting point in a medical patient cycle, students were faced with an actual problem, which was presented in the form of a human–patient simulator (HPS) scenario. In this pilot module, the scenario of a medical nursing theme was built around a case that illustrated the main characteristics of the medical patient. Our objective was to bring out the need for students to seek information about the initial *assessment of a patient* as well as the need to make a plan regarding how to proceed. All three groups were gathered together to follow the simulation. After the scenario was run, students were divided into their own tutorial groups. Students formed a learning task based upon the observed simulation (PBL cycle, step 5; see Figure 2). After that, the process of knowledge acquisition was started by specifying the learning task and writing the scenario for simulations.

Simulations as a process for knowledge acquisition within PBL

Simulation is one way to seek information on the learning task. Since the independent part of studying forms a large part of the knowledge-acquisition phase in the PBL cycle, we were forced to seek new ways of using simulations in that phase. Written scenarios are based on the learning task and their function is to bring the theoretical subject matter into the learning process. The written scenario also clarifies the learning task. Consequently, to be able to write the scenario, students have to seek information about the clinical practice and about the disease involved in the case. The other simulation methods that we used were the virtual-based simulation, skill station, a lesson within the simulation, the in situ simulation, and full-scale simulation.

Written scenario

Simulation scenarios are used to learn clinical skills as well as communication and teamwork. The traditional approach to simulation scenarios is for the instructor or lecturer to plan a scenario according to the learning objectives and then to run the scenario. After the scenario, students reflect on their feelings and emotions in a debriefing session.

Instead of just enacting the scenario, we encourage our students to write their own scenarios that can be used during our exercises. To be able to plan a good scenario, students have to learn the facts around the case and try to find out the implications that a certain condition has on the patient. They also have to figure out how the situation should be treated and what actions need to be taken. Planning the scenario is a great way to seek information, and, more importantly, encourages using that information in a reasonable way to achieve the desired outcome.

Running the written nursing scenario is a good way to enhance the student's ability to react in dynamic, sometimes escalating situations. They have to take into account all of the different variations that the scenario might have, and they have to plan the necessary actions that they might have to take while running the scenario for their fellow students. This has appeared to be very interesting and rewarding for the students. It also seems that students who have taken part in the scenarios as an instructor have developed a way of foreseeing upcoming situations better than they did before the scenario.

The gap between theory and practice is getting smaller and students are able to see the link between theory, protocols, and the actual work. The actual learning objective for scenario planning is determined by the learning task of the group. If they already possess a great deal of knowledge about something, the learning objective has to be redefined toward an area where they lack the relevant knowledge.

Table 1. The elements of simulation pedagogy[1]

Factors	**Written nursing scenarios**	**Full-scale simulation**	**Lesson within simulation**	**Skill stations**	**Virtual-based simulation**	**In situ simulations**
Core competences	Clinical skills Decision making Communication Client and patient orientation	Evidence-based nursing and decision making Communication skills and teamwork Clinical skills Patient safety competence Nursing ethics and professional conduct	Clinical skills Decision making Communication and interpersonal skills Guidance and counseling Nursing ethics and professional conduct	Clinical skills Communication and interpersonal skills Guidance and counseling	Decision making Guidance and counseling Promotion of health and functional capacity	Clinical skills Patient safety competence Nursing ethics and professional conduct Evidence-based nursing and decision making Communication skills and teamwork
Objective and content	Nursing process Nursing care plan Recording patient data	All areas of nursing e.g. medical-surgical nursing, pediatric nursing, antenatal care, mental health care, home care	All areas of nursing	Clinical skills Guidance and counseling	All areas of nursing	Clinical skills, Processes Team work
Tools	Simulators Anatomic models Nursing equipment Frame stories Cases	Simulators Standardized patients (teacher, student, expert patient) Nursing equipment	Anatomic models Nursing equipment Simulators Standardized patients (teacher, student, expert patient)	Anatomic models Nursing equipment	InHospital – Software® Virtual world Virtual IV Online videos	Simulators Standardized patients (teacher, student, expert patient) Nursing equipment
Learning environment	ENVI Classrooms Suitable for independent study	ENVI	Clinical skills labs ENVI	Clinical skills labs ENVI	IT classroom ENVI Suitable for independent study	Authentic place e.g. hospital or health care center

[1] There is much variation as to how a simulation is defined in the field of health care education (Alinier, 2007). RAMK has developed its simulation pedagogy for nursing education since 2005 in an ENVI learning environment. Nowadays, simulation is a part of every module in the nursing program and is meant for every student. This created a need to define the elements and the factors for simulations in our curriculum (Table 1).

When a student is involved in planning the scenario, the feedback is based on the quality of the scenario and therefore also on the quality of their information-retrieval process. The assessment of the scenario is made by peer students, and therefore it is taken seriously, and thus motivates them to succeed in the planning process.

Learning is a cyclical and constructive process. Therefore, the process of knowledge acquisition in the PBL cycle requires a set of methods that support the idea of constructive learning (see Figure 2 and Table 1).

Virtual-based simulations and lessons within simulations are often the first steps toward the learning objective. The idea here is to give students the initial input with theoretical knowledge and to support the transition to more challenging scenarios and exercises. Skill stations bring the practical issues into the learning process and they also prepare students for the full-scale scenarios. Written nursing scenarios and lessons within the simulation can be seen as the experiential part of the cycle, where the theoretical and practical knowledge is put into a context with a realistic setting.

Virtual-based simulation

Virtual-based simulation can be defined as an imitation of reality by using virtual environments or virtual programs on the computer. The range of different virtual methods varies from a basic DVD-video to an immersive, three-dimensional virtual environment. According to recent research, the use of videos is supportive of meaningful learning experiences (Hakkarainen, 2011, 34–53). In this pilot, we used authentic video simulations of the perioperative process in surgical nursing. We also used a virtual self-directed learning system (Virtual IV Simulator) to learn the skills and decision making involved when starting an intravenous (IV) line. Students could practice starting an IV line independently via a virtual program.

Virtual-based simulation is good way to provide individual learning opportunities, and to activate students to seek information, and, more importantly, to test their interpretations in a simulated situation. This brings us to the root of experiential learning.

Picture 1. Lecture with high fidelity HPS.

Skill station

Basic clinical skills were practiced in our simulation center, ENVI. The basic idea of a skill station is to rehearse a specific skill or procedure and the use of specific equipment. A skill station as a teaching method has a long tradition. Cardio-pulmonary resuscitation (CPR) can be used as a basic example of a skill station. We have typically used skill stations before the students begin their clinical placements in hospitals. We have carried out two days of workshops around the topics of the course to give students more confidence and the skills with which to start their clinical placements.

During the pilot module, we focused on clinical skills and decision-making skills during the skill-station training. A basic example could be a case where the student is learning to place an IV cannula into the vein. We used nursing scenarios to highlight the fact that starting the IV line is a process where one has to take into account the clinical condition of the patient as well as the purpose of the IV line; is it for medications, for fluid resuscitation, etc. The clinical condition and other factors force the student to decide what sort of a cannula should be chosen and where to place it. Again, we emphasize the contextual factors during the simulation; the procedure has to be based on the existing situation and the student has to be able to justify his/her decisions during the exercise.

Lesson within simulation

A lesson within the simulation is a combination of a skill station and a full-scale simulation. Most of the lectures were held in the ENVI simulation and virtual learning center. A high-fidelity HPS was used to illustrate the occurrence of different conditions in the patient (see Picture 1). A lecture on resuscitation was run by using the lesson within the simulation approach.

The basic principles of CPR were presented with PowerPoint slides. The right procedure to identify the unresponsiveness and the lack of breathing were demonstrated with the manikin. The lesson continued, and every time it was seen to be appropriate, procedures were demonstrated with the manikin (the right place to give compressions, ventilation, the use of the defibrillator, etc.). Students participated in these demonstrations by taking turns.

The ineffectiveness of traditional lectures and lessons is widely acknowledged. Still, the vast majority of our contact teaching is built around lectures, as it has been for decades now. As lecturers, we are often faced with the challenge of demonstrating a difficult phenomenon and certain details in a way that students are able to understand them thoroughly. It is tempting to try different methods to clarify our message in a more understandable way. For instance, it is fairly difficult to describe what a pulmonary edema sounds like when auscultated with a stethoscope. With an HPS, it is easy to give the experience to students in a realistic way and in a way that makes a clear connection with the theory, practice, and experience. Thus, we are able to target the three dimensions of knowledge, as described earlier in this text.

The lessons within simulations activate students to participate and to ask questions more easily that before. It seems that the existing knowledge is more easily accessed when you have the actual situation at hand. The main advantage of this semi-practical session is that the interaction between students increases exponentially. In our experience, the level of activeness is higher than in regular PowerPoint lessons.

In situ simulation

During the clinical placement, some students had the opportunity to take part of the in situ simulations that were run in the hospital. The main objective for those simulations was to learn teamwork and to enhance the process of care delivery, for example, in an emergency cesarean section situation. The role of the student was mainly to act as an observer during the exercise. The complexity of the situation and the rapid sequence of events challenge the student to apply all of their existing knowledge. The experience is intense and it forces the student to reflect both during and after the scenario (cf. reflection in action and reflection on action, e.g. Schön, 1983).

Full-scale simulation

Full-scale simulations were run after the knowledge-acquisition phase as a part of knowledge integration (PBL cycle, step 7; see Figure 2). Students were able to reflect on their learning and study their competence in surgical nursing. The content of the full-scale simulation was surgical nursing, because the students had been practicing on surgical wards and in operating theatres.

The performance of a student in a full-scale simulation scenario is assessed during the debriefing session. The main emphasis has been on the positive things that have happened during the scenario. The idea is to fortify the correct performance and to support learning with constructive feedback. One of the advantages of a debriefing session is that it helps the transition into the clarification phase of the PBL cycle (PBL cycle, step 8; see Figure 2).

Conclusions

The use of simulations in the PBL cycle brings extra value to the learning process. The two most important forms of simulation from this perspective are scenarios and full-scale simulations. Scenarios are important because they connect the learning task and the knowledge-acquisition phase tangibly to each other. Full-scale simulations are supportive of the integration and construction of knowledge. They are a summing up of the information that has been gathered during the knowledge-acquisition phase.

Based on our experience, the simulations bring extra value for the nursing module in terms of knowledge acquisition. Especially students who have no previous experience in health care find it easier to comprehend different situations and conditions when they are demonstrated with HSPs. Simulation brings the theory into a realistic context and it seems to increase students' interest in terms of searching for more information about the situation. This motivational factor was clearly observed, especially in the knowledge-acquisition phase where the information that students produced was diverse and really got to the heart of the problem. The other great benefit from simulations is in the knowledge-integration phase. All the knowledge and experience gained in the knowledge-acquisition phase is now put into practice in realistic, full-scale scenarios. Using simulations in this phase gives students a clear indication of their current knowledge. PBL complemented with simulation provides an approach for the three-dimensional conception of knowledge (theory, practice, and experience).

Simulation also helps us to find some common misconceptions and correct them early on, before they are too deeply rooted in the student's mental models. This "corrupt" knowledge is usually closely related to common situations that most people have some sort of knowledge regarding. The actions that students take are based on those beliefs, and by running simulations, we are able to recognize those patterns, and then give an alternative idea as to how to handle the situation.

The versatile use of simulations in PBL-based modules produces the desired outcomes in a reasonable way. The main challenge is to find sufficient resources in terms of both staff and equipment. From a teacher's perspective, simulation and PBL share the same fundamental approach to learning and therefore they are supportive of each other in many ways. The challenging part of this approach is to build a meaningful learning process that produces all the competences mentioned in our curriculum. Further research is also needed to develop assessment methods that are supportive of this new approach.

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Simulation and Virtual-Based Learning in a Mental Healthcare and Psychiatric Nursing Module

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Patient safety in Finland is governed by the health care legislation and regulations (Terveydenhuoltolaki, 1326/2010, §8). The focus on the competence requirements of a psychiatric nurse rest on client-centeredness, the promotion of functional capacity, communication skills, and companionship. It is essential that the students are provided with opportunities to practice these skills through simulations (Rovaniemen ammattikorkeakoulu, hoitotyön koulutusohjelma, opetussuunnitelma, 2013–2016, 12, 25). In mental healthcare and psychiatric nursing, communication skills and the skills to encounter another human being play an important role. Each patient must be encountered as an individual who has his own will, experiences, and values that guide his life and way of thinking. The patient's personal resources and his sense of autonomy may affect his ability to be able to participate in the decisions regarding his care. In situations like this, the nurse's ability to provide ethically and morally sustainable care is imperative and is the prerequisite for high-quality nursing care. In addition to the knowledge base of ethics and the respective theories, the psychiatric nurse must have the will and the commitment to take care of people (Kuhanen, Oittinen, Kanerva, Seuri & Schubert, 2010, 150–154).

There are many reports about the benefits of simulation. Simulation improves the students' technical and behavioral skills and gives them more self-confidence. In addition, it enhances the learners' teamwork and communication skills (Kneebone, Kidd, Nestel, Asvall, Paraskeva & Darzi, 2002, 628–629). Furthermore, it also uses the well-accepted concept of adult learning. This means a problem-centered style, immediate experimentation, and reflection on the action without negative emotions (Jeffries & Rogers, 2007, 24–27).

One of the purposes for the ILME project is to identify and institute the best practices in simulation education. The ILME project started in 2012, but developing the simulation for psychiatric nursing had already been started in 2011. Experiences about the simulation are positive.

This article describes how simulation and virtual-based learning have been built into a mental healthcare and psychiatric nursing module during the second year of nursing education. The article explores how simulation is included in the curriculum and is connected to the training and theory. The purpose of this article is to describe how simulation sessions are built using skill stations, sessions, and full-scale simulations in a module for mental health care and psychiatric nursing.

The emotional and ethical aspects of learning

In the curriculum, professional growth is presented as a yearly theme that depicts the nursing and healthcare students' developmental path. The type of simulation depends on the content and learning purpose of the simulation. Simulation can be a basic simulation in the form of a skill station or a full-scale simulation with a well-structured procedural model. An effective simulation environment does not need to be identical to the clinical work environment, but it should provide learning experiences that enable students to meet their learning goals (Dieckmann, Manser, Rall & Wehner, 2009, 20).

The emotional aspects of learning experiences are in focus in mental healthcare and psychiatric nursing. There is a strong, affective element in any learning experience, but in mental healthcare and psychiatric nursing, these elements are one important part of the learning process. A supportive learning environment and positive emotional climate enable the nursing student to face the feelings that the patients awake in them safely.

The extent to which care providers are sensitive to psychiatric patients' sense of vulnerability is crucial to achieving good care. This means that one's privacy is respected, avoiding being reduced to a "problem" and being allowed to choose for oneself. Good care includes a number of activities and attitudes that begin with the students' attempts to understand the psychiatric patient's situation, perspective, and vulnerability, and then to deal with these appropriately. This is an important ethical perspective, which offers the possibility of being able to analyze and evaluate one's own behavior and feelings in the setting. (Vanlaere, Coucke & Gastmans, 2010, 325–326.)

The implementation of simulations

In mental healthcare and psychiatric nursing, clinical skills are mostly non-technical skills. These skills include critical thinking, communication skills, therapeutic nursing interventions, personal and professional development, teamwork, patient safety, and ethics. These skills arise from the generic and professional work-engaged competencies. Simulation and virtual-based

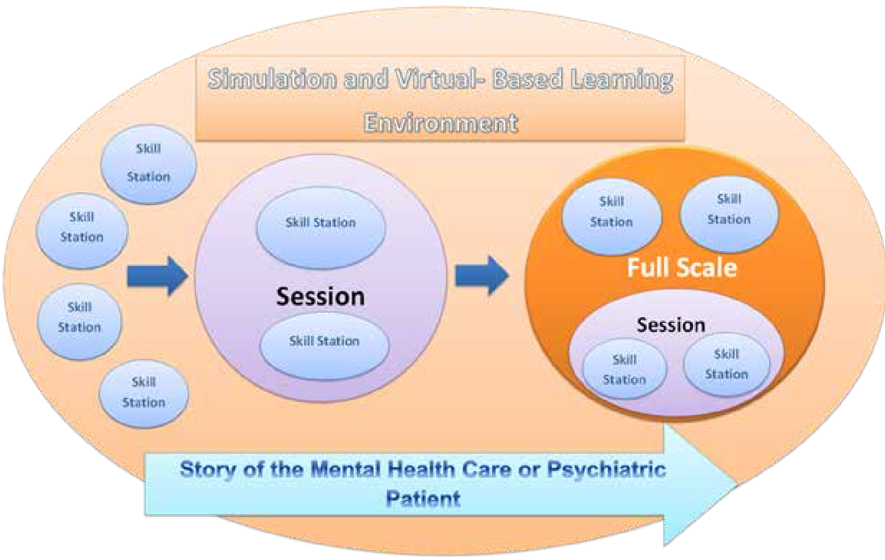

Figure 1. The skill station, the full-scale, and the session simulation in simulation and virtual- based learning environments in mental healthcare and psychiatric nursing

learning environments enable the students to learn the skills that they need using generic and vocational working-life competences.

Sociocultural learning supports Vygotsky's (1978, 84–86) idea of the "zone of proximal development." He defines this as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, 86).

In nursing education, learning happens in a professional context. One part of learning is a process of socialization into the community of practitioners and participating in the sociocultural practices of a community. This process is called "legitimate peripheral participation" (Lave & Wenger, 1991, 29–31; Wenger, 1998, 100–101). All communication skills should then be integrated into larger components. Acquisition of expertise requires sustained deliberate practice, which means that simple repetition is not enough (Kneebone, Kidd, Nestel, Asvall, Paraskeva & Darzi, 2002, 628).

In mental healthcare and psychiatric nursing, a simulation setting can be defined as a social event during which humans interact in a goal-oriented way with each other for different purposes. There are elements of social practices including devices, materials, and the procedures that they use. To participate in a social practice in psychiatric nursing in a meaningful way, one needs to know, understand, and apply its rules (Dieckmann, 2009, 41).

The skill station simulation

Basic simulations are conducted in the so-called skill stations. The trainees get basic nursing skills and acute situation-management tools that are required later during their studies and professional life. There is a possibility for the student to demonstrate their yearly theme-specific skills in the skill stations (Alinier, 2007). These part-task training sessions are designed to focus the attention of the participant on a particular task rather than on a situation (Seropian, 2003, 1696).

In mental healthcare and psychiatric nursing, we use skill stations for training interactions in small groups. Students are trained in specific skills that are used in mental healthcare. The learning is divided into small pieces, which are a part of the wholeness, and this makes it easier to understand the need for practice. Students can train through listening (e.g. mirroring and hot spots) and different kinds of interviewing methods (e.g. the types of questions). Skill stations are tailorable and built to work effectively for groups. There, the students have the possibility to train safely and repeat the skill.

The session simulation

With the learning process in mental health care and psychiatric nursing, the gap between the skill stations and full-scale simulations seems to be too big. To promote understanding in the learning process, we have devised a new step between the skill stations and the full-scale simulations. We call this step the *session simulations*. In this way, communication skills are taught in different kinds of clinical situations, and communication skills are later moved into other situations and nursing in practice. We have broken down the components first, but we start to build them up into a clinical reality by having small cases. This is because there is a danger that a task-based simulation may become a self-referential universe, divorced from the wider context of actual clinical practice (Kneebone, 2005, 549).

The session simulation is an entity or wholeness where the student can train in different fields of mental healthcare and psychiatric nursing. By varying the parameters of the sessions, it is possible to expose the trainees to a wider range of possible behaviors and outcomes in this context. This means increasing basic mental health care and psychiatric nursing interventions. These can, for example, be psychiatric patient education, interviews, or discussions. In a session, students use those communication skills that they have learned in the skill station. They are performing and putting together what they have learned before. By allowing repeated practice in a new environment, the students can strengthen and use their communication skills safely.

A full-scale simulation

A full-scale simulation is a well-structured procedural model and a simulation that is performed according to the same standards. This stage is introduced when the students have sufficient skills to tackle a range of sessions (Alinier, 2007). The instructor has the responsibility of creating an environment that gives the participant a heightened perception of the reality. It is a patient simulation with real physical inputs and real environmental interactivity (Seropian, 2003, 1696). In mental healthcare and psychiatric nursing, this means a wider understanding of the patients' situations. This usually means perceiving the pathway of the patient and multiple dimensions of the social context. This kind of wider way of taking over the situation can be, for example, when the patient is going home from the hospital.

Using the PBL problem

The second-year, "reflective learners'" preparation for the sessions starts from a mental healthcare or psychiatric nursing problem. Problems are triggers, cases, or scenarios. This means that the complexity of the problems differs based on the skills required for the students' training topic.

One challenge in simulating mental health care and psychiatric nursing is ensuring the fidelity of the simulation—the degree to which the simulation reflects reality. Spatial representation includes engaging, saying, doing, and seeing. This creates challenges in properly designing the problem.

The trigger or starting point awakens interest, ideas, and visions regarding the situation. It can be a picture without words, a short video or an audio clip, drama, or other performance. *The case* frames the problem solving more exactly under certain conditions and lasts for one cycle. It means the problem is set in the first tutorial and it is solved in the second one. After that, a new problem is set in the same tutorial. *The scenario* may include a wider and longer perspective of problem solving than the one cycle in the first and second tutorials. Following cycles may focus the learning task on problem areas that have not been covered yet (Poikela, E. & Poikela, S., 2006, 85).

Students must warm up as a group, so they have an immersive experience during the simulation. During the warm-up, role-play immerses the students in a particular clinical situation because the students are acting as themselves. Students gain confidence in their skills, encouraging them to learn more and to look to the future in area of nursing.

Experiences of teachers and students regarding simulation in mental healthcare and psychiatric nursing

The student feedback reveals that simulation practice has lowered the threshold to moving toward real clinical practice. This is due to the fact that during the simulation, the students have been able to practice the very nursing skills that they need in the authentic clinical practice of psychiatric and mental health nursing. Simulations have provided the students with concrete experiences in the context of patient safety, nursing ethics, and client-centered work.

With the model patient cases, the students have been able to understand the versatility of the manifestation of a psychiatric illness in the lives of the patient and his/her family. Furthermore, the students have felt that the simulations have facilitated them to process their own emotions. They have understood the significance of processing one's own emotions as part of professional development, and, consequently, as a quality tool in nursing work.

According to the teachers involved in the simulations, this type of teaching has fostered collegial cooperation and facilitated co-teaching. Simulation education has also enabled collegial reflection about the contents, implementation, and assessment of the courses. Simulation has also improved collaboration between the working-life representatives and the teachers. Teachers also report that their own expertise and working methods in the professional context have become more meaningful and transparent.

The session simulation has given us more possibilities to vary different kinds of situations. Small "wholenesses" help students to train in combinations and focus on a few main points. The learning has proceeded in a step-by-step manner.

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Simulation in Pediatric and Adolescent Nursing: the Case of the ILME Module

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The principle of family-centeredness in pediatric and adolescent nursing means that the nurse must be able to see the child or the youngster in his/her family context. Cooperation with the nurse and the family supports the family members and gives them a feeling of safety in their difficult situation of illness. Empathy and good communication skills help the nurse to encounter the family and plan the care of their child. In simulated nursing situations, the students will be able to have an authentic family-oriented clinical experience and simultaneously broaden their understanding of the concept of family-centeredness in practice in pediatric and adolescent nursing.

The combination of theory and practice in pediatric and adolescent nursing education is very beneficial as far as effective learning and good learning outcomes are concerned. The effectiveness of the combination of these two aspects facilitates experiential learning (Poikela, 2009). It is important that the simulated cases are based on the real needs from working life and that the student nurses are provided with guidance and security. This makes learning of both technical and non-technical nursing skills possible: In this article, we focus on the description and reflection of simulation teaching in pediatric and adolescent nursing studies.

The use of simulations in pediatric and adolescent nursing studies

The use of simulations as a teaching method in nursing is justified by patient safety. Especially in pediatric and adolescent nursing, safety is a key concept in many ways. A safe nursing environment and well-set nursing practices facilitate physical safety. Fears and other psychological issues involving insecurity can be diminished by using age-appropriate, calm interventions to prepare the child for a nursing procedure. The prerequisite for a nurse in dealing with the fears and anxieties of the entire family is the establishment of a trustworthy nurse–client relationship and a genuine ability to encounter people. Furthermore, despite being in hospital care, for social safety, the child should be able to maintain connections with the family, the kindergarten, the school, and his or her friends.

The nursing and health care curriculum in RAMK includes a pediatric and adolescent nursing study unit called “Promoting Family Health.” The study unit is for first-year students who are on the novice level of nursing and public health nursing. It is an orientation to safe and ethical family-centered nursing and offers the students opportunities to gain experiences from clinical nursing work. After these studies the student:

- will be able to explain the development phases of children, adolescents, and families,
- will be familiar with the challenges inflicted by changes and crisis in families and how they affect parenthood,
- will be able to implement with guidance a nursing care plan for pregnant clients, new mothers, and families, and for the care of children, adolescents, and their families,
- will get tools to implement client-oriented, goal-oriented, multicultural, and multi-professional collaboration, and will be able to take into account the personal resources of the individuals and families in nursing work,
- will know how to safely apply clinical nursing skills in maternity health care and family nursing,
- will be able to apply the principles or pediatric, adolescent, and family nursing in the guidance, counseling, and care of individuals and families,
- will gain the skills and knowledge to support families by promoting lifestyles that foster the growth and development of children,
- will know how to apply appropriate nursing interventions to support parenthood and inclusion in society, and
- will be familiar with the array of support and benefits that society offers families with children.

(Rovaniemen ammattikorkeakoulun opetussuunnitelma, 2013)

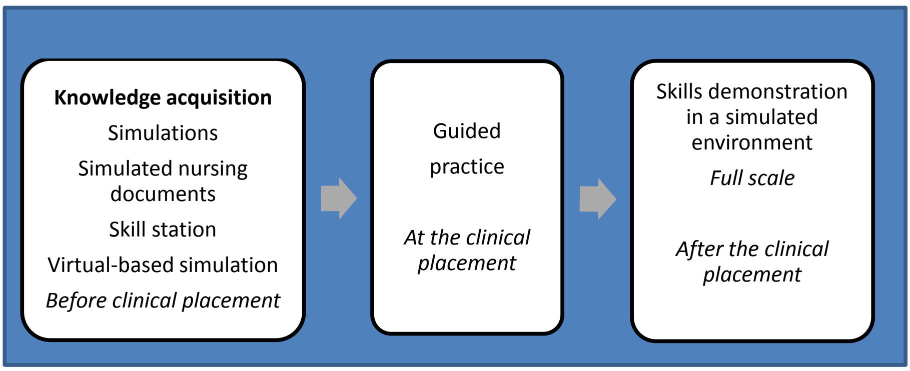

Figure 1. Structure of the study unit and timing of simulations

It is evident that not all pediatric and adolescent nursing skills can be practiced in simulated situations. However, the skills that can be practiced in simulated environments, provide the students with safe learning experiences in this demanding field of nursing. Simulated learning has its time and place today as the practice opportunities in real life have become less due to the increased focus on outpatient care. Additionally, emergency situations in pediatric nursing are actually relatively rare in real life (Nurmi, Rovamo, Maisniemi & Markkanen, 2013).

Figure 1 illustrates the structure of the study unit and the timing of each simulation during the study unit. By knowledge acquisition, we refer to the theoretical study periods as part of the PBL method (Poikela, E. & Poikela, S., 1997; see also Poikela, Tieranta & Vatanen, the article in this book). Simulation learning in groups combined with PBL methods generates and fosters communication, data retrieval, and problem-solving skills needed in any work community (Schmidt, Vermeulen &Van der Molen, 2006).

The *Simulated nursing documents* simulation aims to provide the students with knowledge and skills in the context of the growth and development stages of a healthy child. During this simulation, the students learn to explicate the elements of a nursing care plan in the case of a child who gets ill or who has been abused. One of the aims of this simulation is for the student nurse to learn how the principles of nursing, pharmaceutical care, and pain management, based on the nursing report, actualize. The learning material for this part of the study unit includes nursing reports in the context of growth and development of a 4-year-old, type 1 diabetes in a 9-year-old, pharmaceutical care and pain management of a teenager, and a suspected child-abuse case.

The learning objectives of the skill-station simulation are the technical skills needed in pediatric and adolescent nursing. Alongside this, the student learns how to encounter, guide, and counsel parents and children. The tangible skills learned in the skill station are height and weight measuring, measuring the circumference of a child's head, nutrition and exercise guidance, holding, basic child care, the techniques of removing a foreign object from the airways, resuscitation of a child, anaphylaxis care, preparation of a child for a procedure, pharmaceutical care, and pain management in children.

Virtual simulations through video material teach the student nurses about the development of speech, early interaction, assessment of neurological development in children, and the significance of play in pediatric nursing. Full-scale simulations are used at the end of the study unit as a skills demonstration and practice to show how the knowledge and skills have been adopted. The learning situations comprise anaphylactic shock, CPR, type 1 diabetes, an emergency situation, gastroenteritis, and a respiratory tract infection.

Table 1. The elements of simulation in the pediatric and adolescent nursing study module (adapted from Tieranta, 2013)

Factors	**Simulated nursing documents**	**Skill station simulation**	**Virtual-based simulation**	**Full-scale simulation**
Competence	Clinical nursing	Clinical nursing Guidance and counseling	Clinical nursing Promotion of health and functional capacity	Clinical nursing Guidance and counseling Promotion of health and functional capacity Work community competence
Contents	Pediatric nursing process Documentation	Technical skills Guidance and counseling	Monitoring growth and development	Nursing care of healthy children and adolescents Nursing care of sick children Teamwork Multi-professional cooperation Technical and non-technical skills
Tools and equipment	Nursing reports Frame stories Cases	Anatomical models Nursing instruments Simulators	Videos	Simulators Patient actors (teachers, students, expert patients) Nursing equipment and instruments

The elements of the simulations in the study unit

The objective of the simulation teaching is to achieve learning results in clinical nursing, health promotion, and in the promotion of functional capacity as well as guidance and counseling in pediatric and adolescent nursing work. Through team and group work, the students will also gain competencies needed in multi-professional work communities. Table 1 shows the elements of the simulations used in the study unit and the skills and competencies that are achieved in the process. The contents and tools used in the simulations are also presented in the table 1.

The use of simulations produces competence in various aspects, as can be seen in Table 1. The competences have been described according to the new competence descriptions of nursing. The contents of the simulations are based on the competence requirements and the equipment used in the varied simulations according to the function and the objective of learning.

Conclusion

Pediatric and adolescent nursing is considered by many experts as more demanding than the nursing of adults. Pediatric nurses must master the growth and development stages of children and adolescents and the special features in the nursing of children and adolescents of various ages and sizes. The instruments and equipment in pediatric nursing vary in size and therefore the health care providers must have versatile skills to be able to use them (cf. Nurmi et al., 2013).

In the nursing of children and adolescents, their families are part of the holistic client-oriented care. Simulation teaching facilitates the practice of both technical and non-technical skills and interventions e.g. in emergency situations. Student nurses can also practice communication, guidance, and counseling skills in simulated situations before they go for the actual clinical practice periods on pediatric units and wards. Premastering the nursing skills needed in real life bolsters the student's confidence and feelings of security as they begin their clinical practice outside their educational establishment.

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II RESEARCHING COMPUTER RELATED SIMULATION

Developing Strategies for Computer-Assisted Learning: a Case of Perioperative Nursing

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Compiling an educational application is a complicated process that requires expertise in learning, subject matter, and the applied technology. Rarely, however, are any of these areas of expertise present when putting up an "e-learning" substitute for face-to-face teaching. Rather, in the current era of ICT hype, technical solutions for teaching practices may seem to be proposed on a fairly shallow basis: Anyone who masters the usage of simple application developing tools is considered competent to design an educational application.

We argue, however, that designing an appropriate educational application should be based on sound expertise on human learning. The design process of an educational application is actually very similar to the design of any learning session.

In the current chapter, we outline the process of undertaking the background work for this development process. Our aim is not to provide adequate guidelines or cover all possible context areas.

To illustrate our approach, we present a case study in which the assignment was to design an educational game for perioperative nurse education. The game contains elements that can be classified as simulations. The case study thus covers a discussion about games and simulations, but the general principles to be presented are highly valid in any form of interactive educational application or learning setting.

The structure of this chapter reflects the proposed process of undertaking the background work for educational application development. First, the aims have to be formulated in terms of an applied view of learning (subsection "Pedagogical aims as a starting point for the design of an educational application"). Second, the means to achieve the aims are chosen based on the aims (subsection "Choosing the form of educational application for professional skills training"). Both subsections draw from the context of a case study called PIUHA (Computer-assisted perioperative skills learning and patient counseling). This project is funded by the ESF in Finland and is a three-year joint project by Jyväskylä University (Department of Computer Science and Information Systems), JAMK, and the Central Finland Healthcare District. It was launched in February 2011. In this project, one main objective is to discover and invent educational solutions to intensify perioperative nurses' and nurse students' skills learning through computer-assisted learning (CAL) methods.

Pedagogical aims as a starting point for the design of an educational application

The purpose of constructing an educational application should be to promote learning. Therefore, learning objectives should be the primary criteria in all stages of the development. Learning objectives should be used as the starting point of the construction as well as for the justification of choices among design options. They should also direct all of the activities throughout the development process. After the development process of the application, the learning objectives should be applied to evaluate the product and its utility.

However, it is far from self-evident what we are talking about when we refer to the objectives of perioperative nurse education. What do we mean by learning objectives? Are we referring to formal objectives that are written in curricula, or the objectives that the teacher is implementing and which arise from numerous sources, of which formal documents are only one part? In this chapter, we try to present the core meaning of pedagogical aims in the context of perioperative nursing skills learning, and we discuss similarities and differences between the formal curriculum and the so-called hidden curriculum.

To figure out the real objectives of perioperative nurse education, we organized two focus-group sessions for teachers of nurse students in the PIUHA framework. In each group, three experienced nurse teachers discussed the curriculum on perioperative nursing. The sessions were moderated by a researcher. The discussions were transcribed and analyzed in terms of the conception of learning that they reflected. In the classification of different learning conceptions, we utilized the traditional division into behavioristic, cognitivist, and constructivist views of learning, whose background is described in the next subsection.

Learning theories and their reflections on education

According to the behavioristic view (e.g. Kimble, 1967), learning is explained as a "relatively permanent change in a behavioural potentiality which occurs as a result of reinforced practice." However, this is radically different from what learning means according to constructivism, which is often referred to as the "current" theory of learning. The behavioristic view of learning originates from the work of John B. Watson, whose stimulus–response (S–R) model was proposed to explain all human behavior. Its basic idea—reinforcing desired behavior and quenching undesirable behavior—was applied to everything that could be associated with learning and teaching, from rats in mazes, to academic studies.

The behavioristic view of teaching is roughly seen as transmitting or "feeding" the information from teacher to student, and this view also sees the transfer of knowledge from one context to another as a very straightforward and simple process. Programmed learning is one example of how the behavioristic view of learning is applied. Game playing usually contains many behavioristic features, such as reinforcement of a desired behavior and the quenching undesirable behavior through receiving points, or money, or losing virtual lives. In educational games, however, especially in those dealing with professional skills, the feedback should be more versatile, and learning should obviously be based on understanding rather than on avoiding punishment. Behavioristic elements in teaching also make the students highly dependent on the teacher and may lead students to perform tasks only to please the teacher, and not to actually learn the subject in question.

Computer-based educational applications do reflect the conceptions of their developers. Thus, there is both a theoretical view of learning and a practical one. Behavioristic learning theory is easy to adopt and apply, and probably therefore successfully popularized and used by game designers. However, it fails to satisfy the need to analyze learning processes as mental events, such as thinking and problem solving. In the late 50s, the development of learning theories relied more and more on the cognitive sciences. Cognitive theories (cognitivism) take learning as the acquisition of knowledge and changes in mental stages such as thinking. Consequently, what behaviorists called learning, is, in the cognitive view, only a consequence of learning. The common feature in the behavioristic and the cognitivistic views of learning is that they both see supporting learning as affecting the learner in a predetermined way. On the contrary, the constructivistic view of learning sees the learner's experiences as a basis for subjective knowledge construction and learning is actually seen as a result of individuals' subjective interpretation of each situation.

For a constructivist, learning is more individualized, according to, for example, Cooper (1993): "problem solving based on personal discovery." Learning according to the constructivistic view should allow metacognitive aspects such as self-assessment and self-monitoring and the earlier experiences of the learner should be taken as a starting point in education. An educational game applying the constructivistic view should allow learners to experience and explore to enhance their thinking and problem solving as well as their metacognitive skills. What is also noteworthy is that learning is also a social process, and in the educational game in this particular context, the meaning of a team in perioperative work should be highlighted as well. The social theories of learning also highlight the meaning of adequate instruction and guidance during the learning process.

In the context of computer-based educational applications, skill acquisition is one central issue to talk about. In the operating-theatre (OT) context, acting accurately and according to protocols and rules is important, but the action has to be based on understanding as well. In the cognitively oriented approach (e.g. Fitts & Posner, Anderson), there are two kinds of knowledge, declarative ("knowing what") and procedural ("knowing how"), which are understood to support each other in the three-stage process of skill acquisition. The first stage is called the cognitive phase, in which the learner is trying to understand the task, i.e., to acquire declarative knowledge on the task. In skill acquisition, declarative knowledge is knowledge about the new skill in terms of existing skills. Second, in the so-called associative phase, declarative knowledge is applied to an action and procedural knowledge begins to emerge. Gradually, through practice, inappropriate patterns of action are rejected and new patterns are generated. In the final or autonomous phase, less and less cognitive control is required to perform the task; the skill becomes automatic. In perioperative game development, skill automatization is seen as one central objective; it saves cognitive resources for the performance of other tasks that are relevant in the context of the skills needed in OT conditions. Automatization is useful, but it is also important that an adequate level of control is maintained in order to be able to react to exceptions, i.e., when an automatic skill is not applicable as such.

In many literal sources on learning theories, different theories are handled in their historical and philosophical context. Different theories are seen as conflicting with each other; learning implied quite a different thing for a positivist in the 1960s than what it implies for an educationalist in 2013. We have argued, however—in line with Ertmer and Newby (1993)—that different conceptions of learning merely deal with different qualities. The process of learning multiplication tables by heart does not have much to do with a process of constructing an overall view of a state of a patient. Therefore, we do not cling to a certain view of learning, but handle them as discrete, incommensurable conceptual frameworks. The important thing is what the designers of an educational application mean when they talk about learning.

Perceived conceptions of learning in the case study

In the case study, the focus group discussions were based on a proposed formulation of learning outcomes of perioperative nursing education. The researchers first prepared an initial version on the basis of documents found in the archives of JAMK. In the initial version learning outcomes were divided to knowledge, skills and attitudes, each of which was handled concerning theoretical, professional, social and ethical aspects.

The proposed classification of learning outcomes was generally found appropriate in both focus groups. However, the inclusion of social and ethical aspects evoked astonishment among these teachers – it appeared, as expected, the focus of learning objectives being in the listing of professional skills. It was all the more interesting to analyse the discussions in detail to get a better view about the conceptions of learning that the teachers indicated in the discussions.

The transcribed discussions were analysed sentence by sentence. Two researchers then interpreted each statement, including reference to learning and classified them independently. At the end, the two independent classifications were synthesised by discussing possible conflicting interpretations. In other words, it is a question of subjective interpretation of individual verbal expressions.

For instance, when a teacher stated something like "correct knowledge transfers in correct form" when discussing the learning objectives, the statement was classified to reflect a behavioristic view. In it, knowledge was a piece of information that was supposed to be copied from one place to another. Likewise, "The professional aspect focuses on hard-core, clinical, kind of trick-centric knowing" was located in the same category. "While here we have a list of skills, the knowledge should be seen in that one is able to justify why I'm doing this or that" was seen as an instance of a cognitive view of learning; one was supposed to be aware of the related cognitive processes. In the discussion about professional knowledge, an expression "or experiential knowledge; tacit knowledge" was interpreted to reflect a constructivist view, as well as "critical assessment and reflection also fit in the attitude box; they relate to professional growth."

The findings are summarized in Table 1. In the table 1, the abbreviations refer to behavioristic (Be), cognitivistic (Cg), and constructivistic (Cn) views of learning. The distinction between procedural and declarative knowledge is indicated by "Pro" and "De," respectively.

Table 1. Summary of the interpretations

Session/ Teacher	Be	Cg	Cn	Pro	De
1/1	8	5	8	8	9
1/2	2	4	5	3	5
1/3	12	14	12	13	22
2/1	7	1	5	4	9
2/2	3	5	2	3	6
2/3	10	12	4	5	13
Sum	42	41	36	36	64

As can be seen in the table, statements were relatively evenly distributed among different learning paradigms. This was surprising, especially when considering that the comments in the focus groups concentrated heavily on professional skills and knowledge—we expected behavioristic views to dominate. Only after a careful analysis of the discussions did we realize how amazingly diverse the learning conceptions were.

From the case study, we concluded that not only did the teachers formally accept the importance of having multiple perspectives on learning, but also their verbal expressions revealed that they had adopted a sophisticated conception of learning. Deriving from the variety of conceptions arising during different points in the conversation, it can be argued that the conceptions of learning were not purely based on book learning, but also on practical experience.

Formulating the objectives for an educational application

What would then be an appropriate format for educational objectives in an application? When we discussed this with teachers of perioperative nursing, it became evident that the categorization we used was found to be both sensible and revealing. With the help of this categorization, the teachers had to take into account different aspects of learning.

Certainly, for the implementation of an application such as a set of objectives, considering different aspects of learning is essential. However, what we also found was that for the teachers themselves, the discussions were revealing. In other words, the process of formulating the objectives made the teachers see what was essential in the context area. The old cliché, "process is more important than the product," held amazingly well in this case study.

Choosing the form of educational application for professional skills training

Computer technology and usage has undergone great changes during the last two decades, which mainly include the changes in the role of the computer from a freestanding device to a mobile constituent of a worldwide network. Still, the interaction between the user and computer is basically the same as well as the manner of supporting learning in educational applications. Most of the existing applications can still be categorized according to the early notions of CAL as:

1. Tutorial instruction (should not be confused with e.g. a tutorial group). Based on behavioral strategies and programmed learning of the 1960s. Conventionally presents information, asks a question, and provides feedback. In the learning of skills relevant in perioperative work, tutorials are probably applicable if the skill can be articulated as a sequence of actions, for instance, preparing a patient for an operation or if an automatization of the skill is desirable.
2. Drills (also referred to as drill and practice). Have been found to be effective in the development of skills that need much repetition to be learned. Based on both behavioral and cognitive strategies. In perioperative work, drills would be useful in the learning of e.g. the insertion of a cannula.
3. Simulations. Usually include instructional content. The essence is obviously in the imitation of a given phenomenon. The foremost rationale for using simulations instead of real environments is assuring patient safety and that the expensive OT time should not be used for training in basic technical skills. In nurse education, organizing the teaching in an authentic OT is rarely even an option, and simulations have to be used instead.
4. Instructional games. The use of games in CAL is usually justified with an assumption of increased motivation. To acquire perioperative nursing skills, the game approach could be used to increase motivation for repetitive training. On the other hand, games should be relatively easy to use and should not contain serious usability problems to decrease motivation.

Tutorials and drills are still widely used applications in education, even though the constructivistic view of learning manifests at least in the modern educational literature and curriculum design today. It is therefore important to understand that the CAL types are not mutually exclusive; instead, they are in practice highly overlapping. For instance, a game may contain instructive (tutorial-like) sections; or a drill may simulate a real environment.

Results: From objectives to means

We summarize the arguments above by presenting a table that incorporates different views of learning, applicable CAL types, and certain thematic areas of the curricula for perioperative nurse education. In Table 2, the objective areas are a synthesis from various sources (see Pirhonen & Silvennoinen, 2011), which deal with the curricula for perioperative nursing education.

Table 2. Sketch about the applicable strategies and CAL types

Objective areas	Applicable strategy			Applicable type of CAL			
	Behavioural	Cognitive	Constructivist	Tutorial	Drill	Simulation	Game
Technical skills	***	**	**	***	***	***	***
Situation awareness	*	*				***	***
Decision making			***	*		**	**
Teamwork						**	**
Communication			**			**	*
Leadership			**	*		**	*
Task management			**	**		**	**
Stress management	**	*	**		**	**	***

The evaluation of applicability is based on subjective assessments by the researchers in this particular context, so different evaluators with different settings may have ended up with a different grading. It is important to understand, however, that the essence is not to choose the objectively best form of CAL type, but rather to work through the table in order to become aware of different options, their strengths, and weaknesses in each situation.

The process of the necessary background work for an educational application is thus as follows:

a) Define the objectives of the application.
   - Articulate objectives in terms of an appropriate classification, e.g. the one used in our case study: knowledge, skills, and attitudes, each of which is divided into theoretical, professional, social, and ethical aspects.
b) Classify objectives according to the applied learning paradigm (behavioral, cognitive, constructivist).
c) On the basis of the previous steps, consider the possible CAL types, e.g. with the help of Table 2.

As can be seen in Table 2, simulations and games appear to have much potential in the implementation of educational applications for nursing. It has to be stressed, however, that since nursing includes qualitatively different kinds of objectives, each object type requires individual forethought. The strength of contemporary information technology in education is that it is possible to incorporate different sorts of material within one application in terms of objectives. For instance, simulation-like sections may be included in almost any kind of instructional overall structure.

Based on the analysis described above, it is possible to prepare an assignment for the implementation of educational applications. The analysis would contribute to:

1) the decision on the form of applied technology—the chosen form would then support the objectives;
2) pedagogically appropriate material, thus resulting in effective learning material; and
3) the criterion for the outcome—the resulting educational application can be evaluated in terms of the objectives.

Conclusion

One could claim that the scale of background work proposed in this chapter is overly ambitious. We are, however, convinced that this kind of analysis of the aims and means is not only necessary, but also cost effective. There are plenty of examples of educational applications that do not serve their intended purpose. Investing a lot in an application that can never reach the educational objectives is a pure waste of resources. To avoid such a situation, it is essential that the designer (or design group) is fully aware of the ultimate pedagogical objectives. To reach them, they also need to understand the different views of learning, and which of them is applicable for the given objectives. In addition, they need to be able to choose the optimal CAL type in terms of context and objectives.

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Computer-Based Simulation for Official Communications

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Simulation has been used as a teaching method in many fields for several decades (Rosen, 2008). Armies have used simulation-based education since the Second World War, but the technique can be traced back to the 1800s, when simulations were used in the teaching of fencing. Since the late 1990s, simulation-based learning has expanded very rapidly to the field of healthcare, and can be classified into computer-based, screen-based and human-based learning, depending on the type of simulation. This study focuses on computer-based learning. Healthcare employees practice not only single skills, but also entire working processes, to ensure patient safety, and one of the most serious gaps in healthcare processes is poor communication.

In this article we elaborate how the students' meaningful learning is realized while learning with the computer-based simulation program. Overall aim of the study is to develop a pedagogical model for teaching and learning with such a programs. Pedagogical model would help planning the instructional process in order for students' to benefit from meaningful learning and gain new skills needed within the healthcare sector. We also agree that this type of training can help to educate the beginners and professional to use the phones in order to enhance the communication and secure their safety. This might be also one way to widen the use of the official phones for other fields than healthcare.

The background of the simulation programme

Public authorities throughout the world have developed networks to secure patient safety. The State Security Network Ltd (Viranomaisradioverkko (VIRVE) network in Finland) serves a variety of authorities. Finnish legislation requires medical sectors to be in readiness to use VIRVE in crisis situations. The VIRVE network utilises a special phone, called a terrestrial trunked radio (TETRA) phone. The primary users of TETRA are the rescue services, the police, and the army; in the healthcare sector, the principal users are emergency experts, especially paramedics. However, use of the network should become more commonplace in all healthcare and social care processes to ensure patient and worker safety, while simultaneously making nursing and medical procedures more flexible. One solution could be effective and efficient education. Could a computer-based simulation programme serve this purpose?

The computer-based simulation programme has been designed to achieve improved and more extensive use of these official TETRA phones. It consists of two main parts; the actual simulator for users and the educational tool for the facilitator. Using the latter, facilitators can build their exercises to suit the students, as well evaluate the progress of the exercise, that is, how much time it takes to complete one individual exercise, and what is the average time of the entire exercise. The computer-based simulation programme can also be used as a pedagogical script for the students' learning process. In the present study, our aim was to explore students' learning experiences with this programme and, in particular, to assess how meaningful that learning was from the students' point of view.

We set the following research question: how does the computer-based simulation programme support meaningful learning for students? We investigated the learning of 17 students, and collected data using various methods. The students' learning experience was evaluated on the basis of the previously developed pedagogical (Facilitating, Training and Learning, FTL) model (Keskitalo, Ruokamo, & Gaba, submitted; Keskitalo, Ruokamo, & Väisänen, 2010). Our study is the first phase in a design-based research (DBR) process (e.g. Brown, 1992; Barab, & Squire, 2004), where the aim is to design a pedagogical model for computer-based simulations. The preliminary implication of the programme is that it is fairly static, which should serve a wide repertoire of users, such as novices, experts and students of rescue, health and social care. Nevertheless, the educational aspect provides some flexibility in setting the targets and focusing the programme according to the needs of the learning group.

The Facilitating, Training and Learning, FTL-model

Evaluation of the students' learning experience was based on the FTL model (Keskitalo et al., submitted; Keskitalo et al., 2010). According to Joyce and Weil (1980, p. 1), a pedagogical model such as this 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'. As previous studies have shown, pedagogical models are especially valuable for educators who use educational technology in their teaching (Kangas et al., 2010; Keskitalo, 2011).

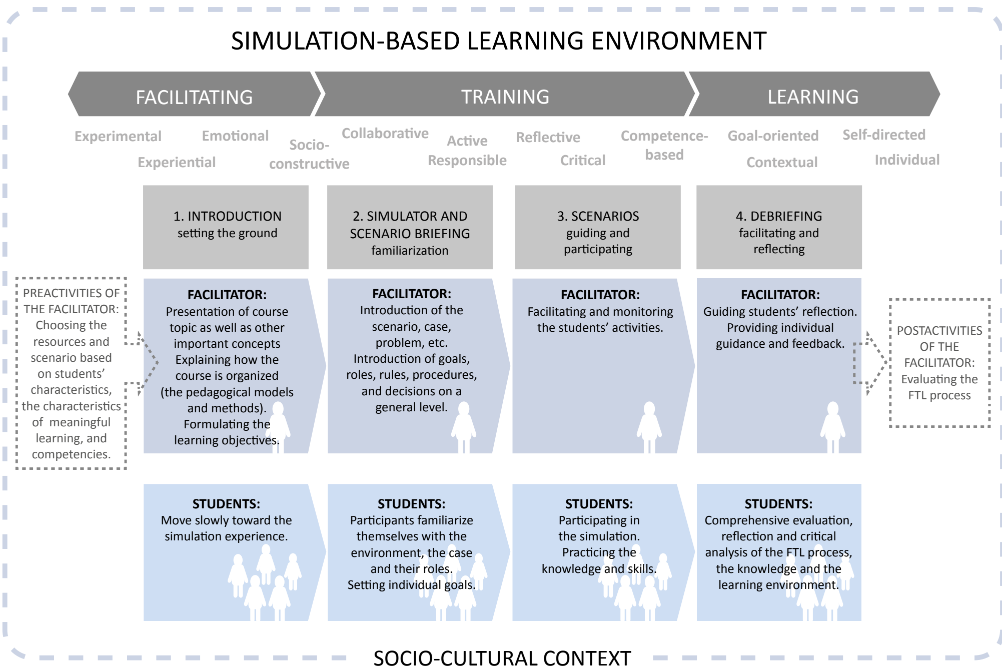


Figure 1. The FTL model of simulation-based learning

The FTL model was designed on the basis of (1) the ideas of teaching, studying and learning processes and (2) the scripts presented by Dieckmann (2009) and Joyce, Calhoun and Hopkins (2002), (3) which are then completed with characteristics of meaningful learning. The FTL model is presented in figure 1.

The basic idea of separating the teaching, studying and learning processes is to place the emphasis on the students' own activity (Kansanen, Tirri, Meri, Krokfors, Husu, & Jyrhämä, 2000; Uljens, 1997). Central to this idea is the fact that teaching does not necessarily lead to learning, but that an individual's own participation is required before learning can be attained. Therefore, in the FTL model, we have attempted to stress the importance of the students' training process. On a more pedagogical level, this model also helps educational practitioners to script the instructional process, which we have divided into introduction, simulator briefing, scenarios and debriefing, as suggested by Dieckmann (2009) and Joyce et al. (2002). However, we have completed these four phases using fourteen characteristics of meaningful learning (see Figure 1).

The concept of meaningful learning was first presented by Ausubel (1968), and has subsequently been further developed by a variety of authors and for different purposes (e.g. Hakkarainen, 2007; Jonassen, 1995; Löfström & Nevgi, 2007; Ruokamo & Pohjolainen, 2000). For Ausubel, Novak and Hanesian (1978), meaningful learning was a process whereby new information is related to what the learner already knows. In this process, the learning materials and the task must be meaningful, but the learners must also be engaged in a learning process.

The characteristics of meaningful learning that we have defined are those that we believe are crucial for students in these circumstances:

- *Experiential and experimental.* These characteristics propose that students can use their prior experiences as a starting point for learning (Kolb, 1984); but they have also an opportunity to gain valuable experiences before real practice. This means that they can experiment with new tools, devices, situations and roles with others (Gaba, 2004; Cleave-Hogg & Morgan 2002).
- *Emotional.* Emotions are always intertwined with learning; in particular, positive emotions are viewed as vital (Engeström, 1982). Emotions affect motivation, but they also have an impact on how we act in a learning environment and what we remember later on (Damasio, 2001). Previous studies have shown that simulation-based learning can arouse strong feelings and motivation, but also disbelief because it is a constructed reality (Dieckmann, Gaba, & Rall, 2007).
- *Socio-constructive and collaborative.* Prior knowledge is a departure point for the construction of new ideas and knowledge (e.g. Ausubel, 1968; Tynjälä, 1999). According to Jonassen (1995), 'learners accommodate new ideas into prior knowledge (equilibrating) in order to make sense or make meaning or reconcile a discrepancy, curiosity, or puzzlement'. Studying collaboratively means that students work in groups, in which they exploit each other's knowledge and skills, and provide feedback and support, as well as model and imitate each other's behaviour (Jonassen, 1995).
- *Active and responsible.* The students' role is to actively find, evaluate and construct knowledge in the course (e.g. Jonassen, 1995). They also engage in problem-solving, meaning-making and the practicing of skills. That is, learners acquire and evaluate information, ask questions and try out different kinds of skills, as well as model and imitate (Ruokamo, Tuovinen, Tella, Vahtivuori, & Tissari, 2002). Activity also promotes students' taking of responsibility for their own learning, since they are responsible for the decisions and the actions they take.
- *Reflective and critical.* Learning is an effort-demanding activity (De Corte, 1995), and needs reflection by students with regard to recognising their own competency level and readiness to receive new information (Jonassen, 1995; Ruokamo & Pohjolainen, 2000). In higher education, students should

also critically evaluate their own learning and acquired information, as well as the learning environment. It should be emphasised that simulation-based learning is a constructed reality, which should be evaluated critically (Hakkarainen, 2007; Lane, Slavin, & Ziv, 2001).

- *Competence-based and contextual.* Learning and development are always bound by the surrounding culture and its wider contexts (Vygotsky, 1978). Therefore, in order to promote learning transfer from simulation-based learning environments to real-world situations, learning tasks should be situated in a meaningful and real-world context or simulated through, for example, problem-based learning (Boud & Feletti, 1999; Jonassen, 1995).
- *Goal-oriented and self-directed.* These features indicate that students are encouraged to set and reach their own learning goals by planning and evaluating their own learning (e.g. Brockett & Hiemstra, 1991; O`Shea, 2003; Jonassen, 1995; Nevgi & Tirri, 2003). According to Knowles (1975), this will also lead to improved commitment to the learning process (cf. Ausubel et al., 1978). Consequently, teachers play a key role in facilitating and maintaining students' learning process. In particular, teachers need the sensitivity to recognise when students are going too off-track, or when they need support or additional guidance (Hmelo-Silver, 2004). Moreover, the learning environment could include equipment that helps students to plan and evaluate their own learning goal (De Corte, 1995).
- *Individual.* Learning is individually different (De Corte, 1995). Students are understood as individuals, who have individual experiences, knowledge, needs, interests and learning styles, among other things. Students also perceive the learning environment on an individual basis (Nevgi & Tirri, 2003). Thus, it is important that teachers provide individual guidance and feedback for all students. As Jonassen and co-authors (2005) put it, 'a key challenge of education is to provide an appropriate educational experience for each student within the context of a class or learning group' (p. 252).

Following the FTL model means that facilitators emphasise students' own activity in the entire learning process, script the simulation-based learning process according to these four phases, and simultaneously account for the student group and their learning objectives, as well as the features of meaningful learning. However, the FTL model is not a strict model; it can be applied and modified. In addition, as facilitators progress as simulation educators they might not require the pedagogical model as frequently, but it can still help to give them new insights into instruction now and then, and would be especially helpful for new facilitators.

Research Questions and Methods

This research focused on the use of a computer-based simulation programme for training in the use of official phones. This study was part of the first phase of a DBR process (e.g. Brown, 1992; Barab & Squire, 2004), which aims to develop the pedagogical model for computer-based simulations in healthcare. This research explored the students' experiences of studying with the computer-based simulation programme, and the following question was set:

How does the computer-based simulation programme support the meaningful learning of students?

To answer this question, we collected data from seventeen first-year healthcare students at Kemi-Tornio University of Applied Sciences. The students initially received general information about the project and the purpose of the course, after which they were informed of the VIRVE network and the use of the TETRA phones. The students were then trained in the use of the phones, via the computer-based simulation programme. In addition, they had four phones that they could actually hold in their hands and use. The students later received information about the simulation-based learning: What is it and why it is important? Six volunteers then participated in the simulation exercise, in which the aim was to learn to use the terminals in a real-life situation. The simulation scenario followed the typical structure of the simulation-based course (*introduction, simulator briefing, scenarios and debriefing*).

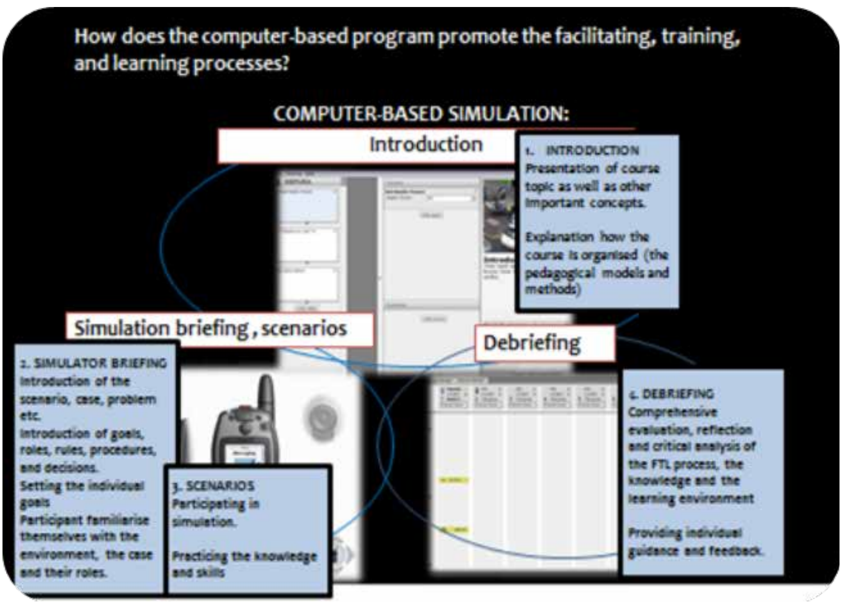
During the course, the data were collected through questionnaires, video recordings, field notes and pair interviews. We analysed the computer-based simulation programme, and this article also includes analyses of the pair interview. The pair interviews were structured on the basis of the interview used by Keskitalo and Ruokamo (see Keskitalo, Ruokamo, & Gaba, 2013), which they had tested on the group of students. The interviews were conducted by the three researchers (two are the authors of this paper), one pair for each researcher. Interviews lasted approximately from 30 minutes to one hour, and were recorded and transcribed. The analyses process started with the authors analyzing the computer-based simulation program. Secondly the first author read the transcribed pair interviews in order to gain an overall picture. This study presents the tentative analysis of the pair interviews. Analysis was performed using the qualitative analysis qualitative content analysis methods (Merriam, 2009; Creswell, 2009).

Tentative Research Results

Phases of the Simulation-Based Learning

The computer-based simulation programme was analysed on the basis of the FTL model for simulation-based learning (Keskitalo et al., 2010), and is the first phase of the DBR. All of the elements of the FTL model could be found inside the programme. See picture 1.

The computer-based simulation programme was divided into three stages, where all of the elements of the simulation process can be found: firstly, an introduction to the course and its aims; secondly, a simulation briefing to become acquainted with the programme and the simulator and learning scenario; and thirdly, a debriefing.



Experiential
Experimental
Emotional
Socio-constructive
Collaborative
Active
Responsible
Reflective
Critical
Competence-Based
Contextual
Goal-oriented
Self-directed
Individual

Picture 1. Computer-based simulation process and meaningful learning characteristics.

In the *introduction* phase, we can find eight meaningful learning features. The *emotional, socio-constructive, reflective, critical* and *individual* features are absent if the facilitator is not involved in the simulation-based learning process. Novice-stage students need the facilitator to support their learning process, and the amount of support required will decrease as they progress in their studies. The students do not necessarily dare to be critical or show emotional responses at the beginning of their studies, but the facilitator can support this activity and take individual needs into account.

In the *simulator briefing* and *scenarios* phases we can find nine meaningful learning characteristics. The *socio-constructive, reflective, competence-based* and *individual* qualities of learning are absent, but can be supported if the facilitator is involved in the simulation-based learning process. The novice students need the facilitator to support their learning processes, and to find competencies that come from practice and when all studying has been integrated.

In the *debriefing* phase, we can find three meaningful learning features. *Experiential, experimental, emotional, socio-constructive, collaborative, reflective, competence-based, contextual, goal-oriented,* and *self-directed* are absent if the facilitator is not involved in the computer-based simulation processes. Debriefing is the most important phase in all simulation types (e.g. Fanning & Gaba, 2007). When we discuss computer-simulation in particular, the students need the presence of the facilitator more frequently during the learning process, especially those in the novice stage.

Table 1 . Themes and excerpts from interview data.

	The Meaningful Characteristics
EXPERIENTIAL	“My old occupation was kind of that it had simulation training, we have done ealier real working life training.”[NS1] “We have just an experience of the lifeless doll like this, but it is very important, so it is quite another thing take care of real patient after practicing.” [NS3] “If you have already been nursing work, you can empathize more in simulation situation.” [NS4] “The realistic training to the future.”[NS5]
EXPERIMENTAL	“I do learn quite a lot by myself by doing… by doing I learn the most.”[NS1] “I can well practice there manual skills.”[NS2] “In simulation training even if it is safety environment, if you do an error, in the debriefing you it stays in your mind, that you have done an error, and you made it incorrectly and that’s how you do it correctly, this way you learn the best.” [NS1] “You can experiment for example nasogastric tube, how it goes.”[NS2] “…that you can experiment it by yourself, not just to see it. You get the feeling.” [NS2] “So it is doing the things which teach.”[NS1] “It stays better in mind when you have been able to do it by yourself, not only listen to someone else who explains how to do it, but you have experimented yourself how to do it.”[NS6] “I think it is important because it is all about human being’s life, it is good to practice at first with this kind of normal doll. With this kind of breathing mannequin practicing is important.” [NS5] “Especially if you have to the things, which you haven’t been able to do ealier, or learn, before you go and practice with real patient, it very important to be able to practice at first with this kind of a mannequin.” [NS6] “It can be nice on behalf of the patients, they can think, that you have trained somewhere, and that I am not someone’s first guinea-pig.” [NS6]
EMOTIONAL	“It’s just such kind of safe feeling, if you make a mistake, it’s here still safe, it can be harder if you make a mistake with a real patient and she/he dies because of the mistake, so it can be hard.” [NS1] “After all you get the experiment of success.” [NS3] “You can feel the simulation frightening and distressing.”[NS5] “I think that the situation is as realistic as possible, so you can emphasize it.”[NS6]

SOCIO-CONSTURCTIVE	“You can acquire more knowledge, a lot of that, you have never learned enough, and you can always learn more” [NS2] “Learning is that kind of a adoption of different things, and you can be sure when you know that you have learnt, so you can be more certain of the things.”[NS6] “It is the collecting of knowledge.”[NS5] “Learning is that kind of an extension of knowledge and skills by observing and doing it by yourself.”[NS1]
COLLABORATIVE	“She/he gives the confidential picture of her/himself, it increases my own confidentiality, too, that she/he knows what she/he is talking about, and I should listen, and learn from her/him. It is very important that she/he has practical experience background.”[NS1] “You can also learn from others’ errors, aha…that you must pay attention to it. It can consider also own doing. [NS4] “Luckily, communication is easy when people are familiar with each other.” [NS4] “I learn very easily, if somebody says an example of her/his own work, so that thing stays somehow in my mind.” [NS3] “Even though I would not be able to do it by myself, but would see how the experts do the things, it teaches vastly. At least I learn that way a lot, when I see what someone else is doing. It stays in mind, and then I can remember how to do it.” [NS1]
ACTIVE	“Teaching has to be exhausting, and I can go on and be exhausted even when I am tired.” [NS3] “I’ve been able to try out by myself and also to talk.”[NS3] “It is somehow so useful that you can use it really. That it was not just a lecture… That way it stays in mind, when I’ve been able to train it myself, too.”[NS6] “I could really use the phone, it was not just shown how to use it, and hold in your hand.”[NS5]
RESPONSIBLE	“If you come in with the attitude, that I’m not going to learn anything here, that way you are not going to learn anything either“ [NS4] “. It is such taking serious. Even that it is only simulation, but nonetheless I think, taking seriously is that.”[NS5]
REFLECTIVE	“I can learn so that I first read it by myself, and then combine it the practice and train.”[NS1] “If you make mistakes, what are the consequences, and then how to act.” [NS2] “You can see it, why it’s done. What is the theoretical base and know how to do it, what are the consequences and so on…”[NS2] “I think it should be multifaceted, so that there would be as many options as possible, how to handle that, so that all would get that knowledge for themselves. So that we would go through the whole entity, and so on.”[NS2] “When you get the feedback, then you learn it, if you have done then, what went wrong, what you did well, then you can remember it.”[NS3] “Giving the feedback. From that situation, if we didn’t have feedback at all, and we’d have gone home, nobody would have known, what is going to happen. Where would the learning take place?”[NS3] “If you don’t get feedback, you won’t learn.”[NS3]
CRITICAL	“ That environment is not is safety or you feel that you get too fierce feedback…that you don’t dare to try either .”[NS1]
CONTEXTUAL	It is very important that you can practice with the mannequin, especially within the nursing field…it is all about human’s life and real human beings. It is very important that it is the right theory and a little the ability, real life ability, which these mannequins give you a possibility to practice, too.”[NS1] “ But also in my opinion it should be as close as the possible sense of realistic situation [NS2] “No, as if there could be the environment of the hospital.”[NS4] “The situation is near by the real life and can practice and have not responsible as we have with the real patient. It can practice in safety.”[NS6] “When this corresponds to the reality, it will be more interesting.”[NS6] “I can practice with the new mannequins, which are breathing, and have pulse. It can be like real-life situation, it increases reliability in doing, and the use of the devices and in the communication and all.” [NS1]
SELF-DIRECTED	“You can better take care of the patient and meet the patient.”[NS3]
COMPETENCE BASED GOAL-ORIENTED, INDIVIDUAL ARE MISSING	

Students' Experiences of Meaningful Learning

Three researcher interviews; the first researcher interviewed nursing students 1, 2 (NS1, NS2), the second researcher did nursing students 3,4 (NS3, NS4) and the third researcher did nursing students 5,6 (NS5, NS6).

Students' excerpts show that the most important characteristic of the meaningful learning is experimental and contextual. It is very understandable because these students were at the beginning of their nursing education, they were novice students. Individuality, goal-oriented and competence-based were missing, and what arose very clearly from all the student interviews, were the lack of support from the facilitator. Students have not yet enough knowledge or skills to construct their knowledge and develop their skill individually, to learn in a goal-oriented way, and they don't have sufficient competencies from their real working life. They need a facilitator's *support.* Only one of the excerpts showed any self-directed characteristics in learning. The students also underlined the possibilities of the training, and that the computer-based simulation program gives them a good opportunity to drill with the mechanical functions of the phone.

Discussion

As preliminary findings, we can state that the students clearly enjoyed training with the computer-based simulation programme, despite our biases. For example, one student said that "she wants to have her own terminal". Another stated that she was expecting that they would sit in the auditorium for the entire day, but that this was clearly more fun and she had learned a lot. It also appeared that the computer-based simulation programme served the characteristics of meaningful learning quite considerably. Those students who attended the simulation scenarios especially benefited, since they also experienced how the terminal is used in actual practice. In addition, the debriefing illuminated learning points that would have been dismissed without it.

Simulations should not stand alone; rather they should be based on the justifiable pedagogical basis. This is also the case with computer-based simulation programmes. They must be grounded within a well-defined pedagogical basis, which was the overall goal of this DBR, in which we wanted to ascertain how the students experienced the training and learning with the specific computer-based simulation programme. This information is important not only when developing the actual simulation, but also the education. The information gained from this research benefits not only the developers of the simulator, but also the educational practitioners, especially within the healthcare sector.

The students were very satisfied with the self-directed computer-based simulation training, and were capably of very quickly using their TETRA phone in the subsequent simulation. They could use basic key bottoms without a second thought.

The students were at the beginning of their professional growth in nursing, and were at the novice stage of education, and this particular computer-based simulation programme was sufficient for them. We also noted that participating computer-based simulation prior to simulation scenario was beneficial for students learning (cf. Curtin, Finn, Czosnowski, Whitman, & Cawley, 2011). However, we identified one limitation within the study; all the students were Finnish and the interviews were conducted in the Finnish language. In analysing stage codes, quotations verifications were translated into English. This could have had an impact on the interpretation of the data. In the future, it would be interesting to know what the experiences of the experts, who already have practical experience of using the TETRA phone in their daily work, have been with regard to using the computer-based simulation programme.

This pilot study shows that a computer-based simulation programme needs different flexible possibilities because of the end-users. New students need more support than advanced learners. Therefore, the facilitators need the sensitivity to recognise the students' experience levels and to give individual guidance whenever needed, notwithstanding all employees in the healthcare sector, who already have more experience from using TETRA phones in their daily work.

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III TRAINING AND ASSESSMENT

Voluntary Simulation Workshops in Nursing Education

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Metropolitan University College in Copenhagen was established in 2008 as a fusion between several educational institutions, after which the Institute of Nursing became the largest nursing school in Denmark with 2500 nursing students. Simulation was not integrated into the nursing curriculum at that time, and the Institute had limited facilities and equipment available for simulation-based teaching. Within the past two years, our faculty has conducted several projects to integrate simulations into the curriculum and it has been a major logistical challenge to organize simulation-based teaching for our large group of students.

A Danish study of student dropout rates from nursing education indicates that difficulties in combining theory and practice are among the motivating factors behind the students' decisions to withdraw (Jensen et al., 2006, 2008, 2010). Furthermore, several studies have highlighted a gap between theory and practice, as well as the need for more practical skills in newly qualified nurses (Muusmann, 2006; Rambøll, 2006).

Nursing education in Denmark has a broad recruitment base, which often presents challenges in relation to the spectrum of students' qualifications. Danish studies have shown that nursing students' study-related skills have changed over the years and it appears that more students are admitted based on "weaker academic qualifications" (Eriksen, Vedsegaard & Pedersen, 2008). According to a Danish study, students can be divided into three types: the *academically oriented*, who do not focus on practice, and the *practice-oriented,* who seem to be surprised by the theoretical focus in the curriculum. The third type, the *profession-oriented* student, values both the clinical and theoretical parts of the curriculum, and considers both areas as important to master in order to become a good nurse (Jensen, 2006). Each of the types requires different teaching methods, while simultaneously embracing students with different backgrounds.

In the light of these studies and based on the presumption that by using simulation-based teaching our Institute could not only meet the challenges posed by the students' differing backgrounds and learning styles, but also meet our goal of integrating simulation-based learning into the curriculum, our faculty initiated the project "Brug cellerne i det 3. rum"[2] (Selberg et al., 2010). The results of this project showed the considerable impact of simulation-based learning on students´ self-perception of learning outcomes, and it exposed a strong demand among students for simulation-based learning. Encouraged by these results and in order to be able to embrace a larger group of students, we decided to prolong the project, and at present, we have experimented with offering additional voluntary simulation workshops, which are

[2] Directly translated from Danish: "Use your brain cells in the third room": the third room refers to a learning space placed in between theory and practice.

beyond the scope of the ordinary lessons, and are aimed at meeting the students' individual learning needs. The workshops took place in the students' leisure time and each workshop had a maximum of 20 to 25 participants. In total, a third of the registered students at the Institute participated in the workshops during the project period.

Aim and methods of the simulation project

The overall aim of the project has been to test learning methods and activities in a simulation-based learning environment that can support the adaptation of theoretical instruction and learning outcomes. Furthermore, the aim has been to test learning technologies and activities that can be used in preparation for the transition from theoretical to clinical training, to better enable students by training them in practical skills before meeting "real" patients in the complex clinical setting, and thereby increasing patient safety.

The principle objective of this part of the project has been to test diverse approaches in simulation-based workshops that are based on voluntary participation and are intended for the individual learning needs of especially motivated students. Furthermore, the project was intended to evaluate the impact of the workshops on the students' theoretical and practical learning outcomes.

In addition, we proposed strengthening the cooperation with clinical partners and students by involving a selected group of clinical partners and students in project activities, in accordance with Metropol's strategy of interacting with clinical practices and by making use of student assistants in research and development (Professionshøjskolen Metropol, 2009).

Simulation cannot be clearly defined, but in the theoretical framework of this project, we have associated it with the understanding of simulation as a training method that aims at simulating a work environment in which essential aspects resemble reality without exposing people to risk (DIMS, 2012). Key aspects of a clinical situation can be copied so that the situation can be understood and managed when a student is confronted with it in an actual clinical setting (Morton, 1997). Based on this understanding of simulation, it represents a broad spectrum of approaches, with the use of simulated patients, low-technical mannequins, part-task trainers, computer-based learning, and a virtual set-up.

The current understanding of simulation also operates within a continuum from "low-fidelity to high-fidelity" in relation to the degree of approximation to reality and is often classified in relation to the technological level of the equipment to be installed. This understanding ranks role-playing and the use of skills trainers at the low end and advanced full-scale patient simulators at the high end (Hovancsek, 2007). Our starting point has been a low-tech approach using basic simulation mannequins, part-task trainers, and simulated patients, and our intention has been to establish the most realistic set-up possible.

Methodologically, the project was inspired by action research where an ongoing change process is established at the same time as the process is being used to develop new knowledge (Malterud, 2003). As a result, the participating students, the group of student assistants, and the team of instructors have influenced the development and ongoing adjustments of the initiatives.

A comprehensive workshop plan was designed with subsequent adjustments and changes being made along the way, as we wanted to test diverse approaches to simulation-based teaching in order to capture the intent-related knowledge concerning possible ways of combining theory and practice, as well as knowledge about how we could meet the students' requirements and different learning styles. The content of the workshops was designed and based on the expressed needs of the students, which emerged from the evaluation of the first part of the project, and these were integrated into an educational context.

The workshops were implemented during the fall semester of the 2011/12 academic year, and consisted of a total of seven workshops, each with a 2-hour duration, and with the participation of a total of 118 students from different levels of the nursing curriculum. The workshops were primarily focused on hands-on skills, but they also included communication and teamwork skills, while continuously concentrating on combining theory and practice.

As shown in Table 1, various teaching methods, themes, and simulation equipment were used in order to accommodate diverse learning styles. Our intention was to design the workshops with elements of visual, auditory, and kinesthetic components, as suggested by Jeffries (2007).

The team of instructors consisted of lecturers with diverse nursing and scientific backgrounds, clinical experts from university hospitals in the Copenhagen area, who were subsequently enlisted as co-trainers and consultants, and a team of students, who functioned as assistant teachers. The themes were selected in collaboration with lecturers and students, so that the educational opportunities were broadly distributed across the different levels of the curriculum and were distinctly relevant to the students because they supported the ordinary lessons within each module.

Table 1. Summary of completed workshops

Voluntary workshops			
Main Topics	Simulation activities	Equipment	Participating students – The Danish Nursing Education is divided in 14 modules
Bed bath of bedridden patient	Bed bath – perineal care	Mannequins	Module 1 +2
Patient with urinary tract infection	Catherization Measurement of vital signs Urine stix	Nursing Anne & catherization trainer	Module 1 +2
Positioning of stroke patient	Positioning of patient	Standardized patients	Module 2-3-10
Oral & tube feeding of patient	Oral feeding Placement of duodenal & feedingtube	Standardized patients & Nursing Anne	Module 2-3-10-14
Wound care management	Removal of necrosis Bandaging	Pieces of meat Standardized patients	Module 6
Intravenous therapy management	Iv cannulation Iv administration of drugs	Iv trainers	Module 10
Cardiac arrest management	CPR Communication in teams	Ambu Man Torsos Individual certification - Resusci Anne Skill Station	Module 10

Evaluation and results of the simulations

Systematic evaluation was incorporated into the project plan in order to ensure a systematic formative evaluation of the learning and development initiatives during the process. Summative evaluation was incorporated for the purpose of evaluating the project's aim and as documentation for the dissemination of the project's results (Dahler-Larsen & Krogstrup, 2003). The evaluation was designed as a method of triangulation between field observations, questionnaires, and focus-group interviews in order to obtain a broad and balanced coverage of the workshops (Malterud, 2003).

A questionnaire using a 10-point scale (1–10) was presented immediately after the workshops with the purpose of evaluating students' self-perception in terms of learning outcomes. Furthermore, the questionnaires included open-ended qualitative questions with a formative design focusing on the students' judgment of the content and set-up of the simulation workshops.

Ninety-seven students (response rate 82.2%) assessed their theoretical outcome on a 10-point scale with a mean score of 7.55 (SD 1.96), the practical skills outcome mean was 8.07 (SD 1.96), the integration of theory and practice mean was 8.27 (SD 1.62), the general outcome mean was 8.36 (SD 1.57), and the outcome from simulation workshops as a method supporting individual learning needs had a mean of 8.64 (SD 1.37).

The main themes that derived from the open-ended questions and the focus-group interviews were identified by condensation of the meaning (Kvale, 2004). In the data analysis, the themes (see Figure 2) that seemed to have made an overall impact on the students' learning outcomes were *hands-on* and *interaction with facilitators and peers*, which appeared to be the main themes from which the subsequent themes of *self-efficacy, motivation,* and *enhanced theory–practice integration* arose.

Another recurring theme was that the students expressed that they learned best by having *hands-on* remedies and by practicing pro-

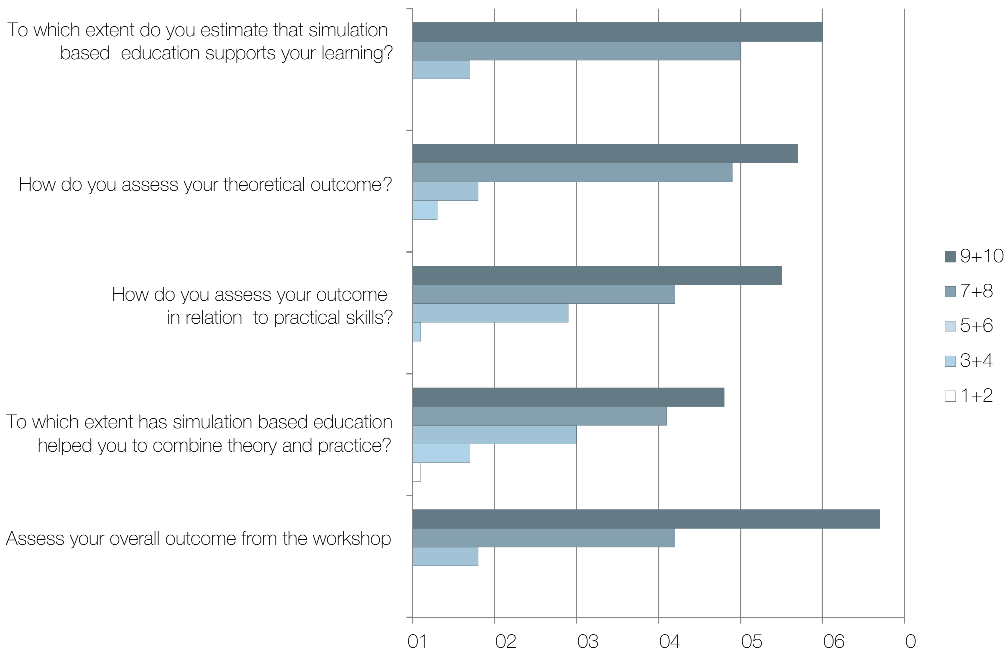

Figure 1.Results of the questionnaire using a 10 point scale

cedures, the result being that different learning styles were accommodated, as expressed by one student.

I have to have hands-on in order to get the theory to stick. It is better to be practical and have hands-on than just having to just sit and read in books.

The possibility of practicing hands-on skills enhanced the process of learning as well as resulting in a feeling of *self-efficacy*[3].The students pointed out that it was important for them to have practiced their hands-on skills before meeting the "real" patients. They felt more confident and less anxious with the procedure and subsequently had the courage to test procedures on a "real" patient. A feeling of self-efficacy and motivation to perform also emerged from successful experiences, as expressed by one student.

It is cool to say I can, I have tried it before and thus experience being able to shine during catheterization, I feel more confident. It is motivating to find out that you can.

Another recurring element in the evaluation was that simulation-based teaching significantly contributed to *theory–practice integration* and clarification of the context, which the student achieved through reflexive learning processes.

The theory makes more sense when you see and do it in practice.

I got a clearer picture of the relationship between vital signs and symptoms.

… the practical teaching makes it easier to remember theory.

The students' participation in the simulation setting was based on different qualifications and experiences, and the workshops seemed to accommodate different learning styles.

There are many different learning styles, people learn very differently, some students one can only learn it if you listen and act.

I can visualize better when theory is combined with practical procedures.

The simulation-based teaching seemed to meet the needs of both the academically-oriented, the profession-oriented, and, in particular, the practice-oriented students. Based on participants' evaluations and the focus-group interviews, it appeared that the training contributed to increasing student motivation in several aspects. For example, it appeared that theory linkage led to increased motivation, as stated by this student.

It's incredibly important with theory–practice integration because you get more motivated.

Furthermore, the students also expressed the motivation for practicing their skills in the clinical setting and for further theoretical studies.

There is a greater motivation to actually understand the theory you have been reading, to put some extra energy into studying it and fill in theory gaps.

The motivation contributed to the students' voluntary participation in the workshops and willingness to spend their free time, as it is expressed here.

I do not mind spending my free time; it's more fun.

I feel privileged to participate.

Potentially, the expressed student motivation can result in reducing dropouts from nursing education.

The students' assessments indicated that simulation-based teaching has given them the

[3] Bandura (1997) has defined self-efficacy as one's belief in one's ability to succeed in specific situations. One's sense of self-efficacy can play a major role in how one approaches goals, tasks, and challenges.

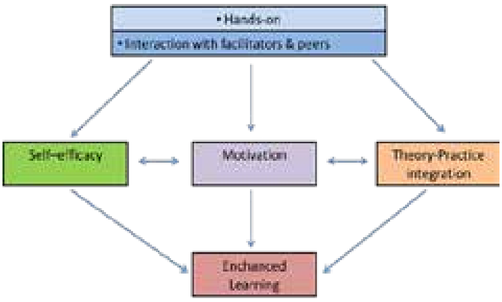

Figure 2. Results of the qualitative questionnaire

opportunity to reflect on their actions, decisions, and knowledge both in an ongoing sense in relation to the specific activities, and during the debriefing, as stated here.

It is highly enlightening, you get to reflect over your own reactions in stressful situations, reflect, and learn from mistakes, and previous knowledge gets refreshed.

The workshops seemed to accommodate enhanced interaction between facilitators and peers that led to reflection, motivation, and enhanced learning. The student's reflection and learning seemed to be enhanced by the facilitators' ability to promote reflection and during an interaction process with peers, where they experienced learning from and with each other.

We could work together and discuss the assignment together.

The results correlated to finding the optimal combination of instructors that proved to be significant for student satisfaction and learning. The students felt comfortable with the school's lecturers, who were familiar persons, but were also familiar with the current syllabus, which could be integrated during action through reflective questions. The students felt that the clinical supervisors were important in order to ensure updated clinical practice and to give good practical advice.

She has hands-on; she knows what's going on.

The students acting as assistant teachers brought their experiences from clinical practice into the classroom and the students expressed the importance of being on equal terms.

She's closer to us, in our situation, showing great understanding.

These findings confirm that one of the criteria for the success of the project has been met; namely, to strengthen cooperation between clinical specialists and students.

Summary of results and conclusion

Both the quantitative and qualitative results indicate that the voluntary workshops have had a positive effect on the students' feelings of self-efficacy, motivation, and theory–practice integration. The results are consistent with findings from other studies dealing with simulation-based teaching, such as the feeling of increased self-efficacy, which has been highlighted in the literature as an effect of simulation-based learning, for example, by Alinier (2004), Jeffries (2005), and Bambini (2009).

Students' self-perception in terms of learning outcomes produced a favorable result from the workshops with respect to both technical and non-technical skills; however, further research needs to be carried out to investigate the impact of the simulation workshops on students' examination results, the transfer of skills to the clinical setting, and the impact on reducing dropout rates from the nursing school at Metropol.

Voluntary and diversified workshops seemed to not only increase motivation, but also provided the necessary response to the diverse learning styles and individual needs of the students. The simulation workshops seem to establish a learning space that not only appeals to academically-oriented and profession-oriented students, but also, to an even greater extent, to the practical-oriented students, which seems to be an important issue, as nursing education in Denmark has evolved toward a more academic approach within the last ten years.

The increased motivation expressed by the participating students, and as we have observed, can potentially contribute to retaining the students in the nursing program and thus reducing the dropout rate.

Our experience shows that it is both rewarding and necessary to involve clinical partners in developing and implementing practice-based teaching. The students have consistently commented that it has been a positive experience to have been taught by a team consisting of teachers from the university college, the clinic, and student assistants, who have all contributed to clarifying questions in a more nuanced manner.

The involvement of clinical specialists has been of great importance in ensuring realistic training in relation to clinical practice, and that participation and dissemination are in accordance with updated clinical procedures. This is clearly evident in relation to highly specialized areas such as wound care, in that the use of clinical specialists has been a particular necessity for the dissemination of practical knowledge within this field, especially since lecturers are limited in their capacity to maintain their clinical skills.

Furthermore, the involvement of student assistants has been a success. In addition to participating in the development and implementation of the teaching, some students contributed to the data processing of the evaluations. The assistant students point out that they found great motivation in helping to develop the workshops in a direction that they assessed as very positive for the school's learning environment. Moreover, their experience has contributed to the development of communication and teaching skills, in addition to an increased personal knowledge at both the theoretical and practical level.

At the present time, the voluntary workshops have become a fully integrated element of the education at the Institute for Nursing, while simulation-based teaching has, to a certain degree, also been integrated into the curriculum. Student assistants have been hired and cooperation with clinical educators has been established. We are continuously engaged in developing our simulation facilities, and are currently in possession of an increasing amount of simulation equipment. We continuously experiment with new approaches and have integrated full-scale scenarios such as a death scenario, a children's scenario, and acute scenarios (sepsis and a bleeding ulcer scenarios). The project "Brug cellerne i det 3. rum" created the basis for the integration of simulation-based teaching in the Institute for Nursing at Metropolitan University College, and the present part of the project has particularly integrated voluntary simulation workshops with great success.

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Measuring Learning Outcomes of Multi-Professional Trauma Teams after Simulation Training

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Simulation is widely used to enhance the development of professional knowhow in medicine and nursing. It is important to recognize the broad spectrum of simulation modalities and devices, and to use simulation in a cost-effective manner. The limitations of simulation must also be recognized and simulation-training programs should be adjusted to the needs of a target group and to the organizations' educational goals. It is important to keep in mind that simulation technologies should supplement, not replace, the traditional methods of teaching cognitive knowledge (Berkenstadt et al., 2013).

Simulation as a method of teaching the trauma teams has a major role in our hospital. Various skills trainers are used for teaching trauma-related procedures to the residents, such as airway management, chest drain insertion, and cricothyroidomy. For teaching the team as a whole, the full-scale trauma-team simulation using a high-fidelity, computerized patient simulator is used. Generally speaking, advanced simulation can be used to improve clinical performance, as well as to assess the competence of the team. We use it also as an induction method for new employees. Training *in situ* in the emergency room enables practicing crisis resource management. In some places, full-scale simulation is used for learning about errors made during critical emergency situations.

In this article, we first describe why the simulation training of the trauma team is essential and how the multi-professional, trauma-team simulation trainings are arranged in the Central Finland Health Care District. Then we discuss how we have developed and used a self-assessment questionnaire, as well as our experiences of using a modified non-technical skills (NOTECHS) scale for trauma (T-NOTECHS). We also focus on the benefits and deficits of using self-assessment as a method in evaluating the simulation-generated learning outcomes.

Why is simulation training for the trauma team crucial?

Trauma is the fourth leading cause of death in the Western world (Trauma: Who cares? 2007, 4) and the leading cause of death in children (Hunt et al., 2007, 796). In 2011 in Finland, there were 239 deaths in children aged 0–14, and in 14.6 % of these cases, the underlying cause of death was accidents and violence (Official Statistics of Finland (OSF), Causes of death).

Trauma management is a complex, time-critical enterprise requiring a multidisciplinary healthcare team comprised of highly trained medical professionals. It poses a unique challenge to the health care system as casualties presenting within the first 2 hours of injury represent the population with potentially preventable deaths. It is this group of patients that can be helped through expert trauma management (Hogan & Boone, 2008, 681).

The purpose of the trauma team is to provide advanced, simultaneous care by relevant health care professionals to the seriously injured trauma victim. If the team is functioning well, the outcome of its performance should be greater than the sum of its parts. Trauma teams have been shown to reduce the time taken for resuscitation, as well as the time to x-ray computed tomography (CT scans), to emergency department discharge, and the time to the operating room. "The primary aims of the team are to rapidly resuscitate and stabilize the patient, prioritize and determine the nature and extent of the injuries and prepare the patient for transport to the site of definitive care, be that within or outside the receiving hospital" (Georgiou & Lockey, 2010).

Trauma teams are typically assembled on an ad hoc basis for individual trauma-resuscitation events, and team members rarely participate together in structured response-team training. In addition, many hospitals do not get enough emergency cases to enable their trauma teams to perform optimally just by doing their regular work. Health care professionals who are not routinely exposed to treating trauma victims need to be regularly trained to assess and manage these patients during the definitive 2-hour time period. Simulation offers multiple opportunities to enhance learning and knowhow in the challenging domain of trauma care (Berkenstadt et al., 2013).

In the trauma-team simulations, there is an increased emphasis on the non-technical skills that can be defined as behaviors not directly related to the use of medical expertise, drugs, or equipment. They encompass both interpersonal skills (e.g. communication, teamwork, leadership) and cognitive skills (e.g. decision making and situation awareness). Nowadays, non-technical skills are seen as an important contributor to reducing adverse events and improving medical management in healthcare teams (Westli et al., 2010, 47), as it has been demonstrated that most of the adverse events are related to human factors. For example, in Finland, there are about 1700 deaths in patient care annually, and operations are one of the four most popular causes of them. Almost half of the adverse events among surgical patients are highly preventable (Kable, Gibbert & Spigelman, 2002).

Research supports that the levels of team skills among operating room teams correlate with the frequency of technical errors and problems occurring during operations (Catchpole et al., 2008). Even if good communication is vital for safe patient care and good team functioning in all areas of health care (Davies, 2005, 898), the communication during trauma resuscitation has been found to be suboptimal (Bergs et al., 2005). The major problems causing poor performance of a trauma team are related to leadership, communication, and prioritizing (Wisborg et al., 2006), and conversely, effective information exchange and communication (Davies, 2005, 898; Westli et al., 2010), as well as leadership (Hjortdahl et al., 2009) are prerequisites for optimal and effective teamwork and safe patient care.

The research on the effects of the simulation team training focusing on non-technical skills demonstrates that training has a strengthening effect on a trauma team's teamwork and communication (Wisborg et al., 2008; Capella et al., 2010; Steinemann et al., 2011; Rosqvist & Lauritsalo, 2013). Prior training in the leadership of a team has been found to be independently related to better leadership behavior among surgeons (Yeung et al., 2012). In our previous study, most of the participants agreed that the trauma-team simulation training was useful, irrespective of occupational group, length of working experience, or number of simulation-training sessions. The training was also considered as a useful induction method for new employees. Some of the participants with prior experience of simulation-based trauma-team training had experienced the transfer of learned knowhow from a simulation environment to clinical practice (Rosqvist & Lauritsalo, 2013).

Multi-professional trauma-team simulation

We started conducting computerized patient simulator-based trauma-team simulation training regularly in 2009. The training is based on the Central Finland Health Care District's directive on its patient care policy for seriously injured trauma victims. This directive is formed in cooperation with surgeons, anesthesiologists, radiologists, and nurses.

Simulation training is developed for the specialists and residents, trauma nurses working in the emergency department, and nurses working in the emergency department, ICU, and recovery room; so-called circulation nurses. The latter nurses are educated to be able to work in all of these three units and they use work rotation to maintain their professional competency. Minimally, the trauma team includes a surgeon, an anesthesiologist, a trauma nurse, and a "circulation nurse," who acts as an anesthesiologist's working pair.

The main instructor of the simulation training is an anesthesiologist and an intensivist. He has a special competency as a medical educator and in emergency medicine. He is an Advanced Trauma Life Support (ATLS) provider and has participated in the Finnish basic course for simulation instructors and in the European Trauma Course (ETC). Nurse teachers work as his working pair (anesthesia nurses). They act as simulator pilots, as well as participating in education as nursing teachers. Nurse teachers have also participated in the Finnish basic course for simulation instructors. An important member of the team is also a technical assistant, who has a major role in conducting the simulations, as the functionality of the technical devices are his responsibility.

Until autumn 2012, the simulation training was conducted in the Center of Medical Expertise (www.tietotaitopaja.fi) using a computerized adult patient simulator (SimMan™, Laerdal). From then on, the training has been arranged to take place in the emergency room of the hospital's emergency department. In addition, computerized patient simulators simulating an infant and 6-year-old boy have been used (SimNewB™, MegaCode Kid™ Vital Sim, Laerdal). The theme of the patient case is changed twice a year. The 2-hour trauma-team simulation course includes clarifying the method, a theoretical lecture, taking on the roles, an initial simulation, a debriefing, a second simulation, and a debriefing. The simulations are video recorded for the debriefings.

In our hospital trauma team, simulation training is used as a regular teaching and learning method to improve and maintain the team's performance. Educational interests are on improving decision making communication, teamwork, authority, being under authority, and practicing single and specific hands-on skills. The aim of the trauma-team simulation training is to enhance the effectiveness of team performance by practicing on these focus areas.

Developing and using a self-assessment questionnaire

We started to develop our questionnaire in 2011 using the Töölö Hospital's trauma-team simulation course questionnaire as a starting point. Töölö Hospital is one of 24 hospitals run by the hospital district of Helsinki and Uusimaa (HUS). We developed the content of their questionnaire further to meet our needs by undertaking a literature review. The questionnaire includes two pages: page one (questions 1–9) is meant to be filled in before, and page two immediately after the simulation training. On page one there are seven background questions: age, gender, profession (specialist/resident), and working experience in years in the current assignment, number of participations in the trauma-team simulation-training course, number of participations in real-life trauma resuscitations, and the date when the individual last participated in real-life trauma resuscitation.

For question number eight, participants are asked to evaluate if the following real-life trauma resuscitation-related issues need improvement: knowledge (textbook, knowledge, guidance), skills (your own hands-on skills), and attitudes (acting as agreed). The answers are given using a 5-point Likert scale (1 = *I don't need*, 5 = *I need a lot*).

Participants' perceptions of their real-life trauma resuscitation-related skill levels (question number nine) are examined using the 5-point Likert scale (1 = *I don't need*, 5 = *I need a lot*). The skills of interest are knowing the trauma-resuscitation guidance, problem identification, decision making, situation awareness/coping with stress, teamwork/cooperation, communication and interaction, time management, single hands-on skills, being under authority, and their confidence regarding their own role in the team. Additionally, the team leader is asked to answer the following three extra questions: use of authority, workload distribution, and conflict resolution.

Page two includes questions 10–13. Question number 10 is identical to question number 8, and question number 11 is identical to question 9. In question number 12, there are two statements: a) the simulated patient case was realistic enough, and b) this time the simulation training was useful for me. These statements are answered using a 5-point Likert scale (1 = *totally disagree*, 5 = *totally agree*). The last question, number 13, is open-ended, and surveys the participants' perceptions of the underlying extra value of training *in situ* in terms of an improvement in knowhow.

A questionnaire is a fast, cheap, and easy method if you keep it short and simple. This is good to keep in mind, since the time spent filling in the questionnaire is usually taken straight from the simulation-training time. In addition, basic statistical analysis of the collected data can be performed effortlessly using the SPSS software package.

To confirm reliable results, it is crucial that the questionnaire measures what it is meant to measure. To ensure this, we reviewed the existing scientific research and literature to find the relevant key concepts related to trauma-team performance and non-technical skills affecting it (see Davies, 2005; Holcomb et al., 2002; Hamilton et al., 2009; Capella et al., 2010), as well as to gain verification of the concepts that we had chosen for the questionnaire: these questions are based on the main instructor's long and broad experience as a clinical specialist, clinical teacher, and a simulation instructor. We also wanted the questionnaire to measure rigorously enough the possible changes in perceived skills levels before and after the simulation training, so we used a 5-point Likert scale. To enable versatile statistical tests, we used more background questions. The questionnaire was filled in anonymously.

We analyzed the data that was collected during the spring of 2013 (22 teams, 109 participants). The results demonstrated that the participants perceived that their skills in decision making, situation awareness/coping with stress, teamwork/cooperation, and communication and interaction had improved as a result of simulation training. These changes in perceived skills levels before and after the simulation training were statistically significant. Team leaders experienced that their use of authority was improved after the simulation training. The results will be published in detail at a later date elsewhere.

A major point when collecting this kind of data is the concrete utilization of the results in future education to develop teaching and improve learning. Especially the open-ended questions enable getting information about the educationally valuable suggestions on the content for future simulations (e.g. suggestions for new patient cases and about the procedures/issues that enhance the transfer of simulation-generated knowhow to clinical environments). We discuss these issues, as well as the participants' experiences of a simulation-generated improvement in knowhow regularly among individuals (the clinical educator, the nurse teacher, a technical assistant, an educational designer, and heads of different units of the hospital) that have a role in executing the trauma-team simulation training. The results are utilized when possible.

T-NOTECHS

A modified non-technical skills (NOTECHS) scale for trauma (T-NOTECHS) was developed to teach and assess the teamwork skills of multidisciplinary trauma-resuscitation teams. T-NOTECHS is based on a psychometrically sound teamwork-rating tool for operating room teams. It is based on five essential behavioral domains, illustrated with exemplar behaviors. These domains are leadership, cooperation and resource management, communication and interaction, assessment and decision making, and situation awareness/coping with stress. T-NOTECHS is a tool that is based on these behavioral domains that could serve to evaluate trauma teams. It uses a 5-point Likert scale (see Steinemann et al., 2012).

T-NOTECHS is evaluated for reliability (intraclass correlation coefficient) and its correlation with clinical performance. According to a study by Steinemann et al. (2012), better T-NOTECHS scores were correlated with better performance during simulations, as evidenced by a greater number of completed resuscitation tasks and faster time to completion. In actual resuscitations, T-NOTECHS ratings improved after teamwork training. Higher T-NOTECHS scores were correlated with better clinical performance, as evidenced by faster resuscitation and fewer unreported resuscitation tasks. In conclusion, the researches state that improvements in T-NOTECHS scores after teamwork training, and correlation with clinical parameters in simulated and actual trauma resuscitations, suggest its clinical relevance. However, further evaluation, aiming to improve reliability, may be warranted. Despite this, we wanted to use T-NOTECHS as an additional tool to evaluate learning outcomes.

The instructor of the trauma-team simulation training acted as a T-NOTECHS expert rater in all of the teams. He filled in the forms immediately after the first and the second simulations involving the teams.

We used the T-NOTECHS to supplement the participants' self-assessments. We had the same expert rater in all simulations. It is likely that using the same rater who has a long and broad experience as a clinical specialist, and as a clinical teacher, as well as as a simulation instructor, increases the validity of the results. However, in future, we will use two expert raters to see if their answers correlate with each other. On the whole, our experiences of the T-NOTECHS were positive. It is a simple and easy tool to use. It can be filled in shortly after the simulations, so it does not disturb

Table 1. Trauma teams' (N = 22) non-technical skills after the first and the second simulations according to T-NOTECHS

Domain variable	Mean score after the 1st simulation	Mean score after the 2nd simulation	p value
Leadership	4.27	4.73	.015*
Cooperation and resource management	4.00	4.59	.001*
Communication and interaction	3.77	4.36	.000*
Assessment and decision making	4.18	4.45	.083
Situation awareness/coping with stress	4.05	4.41	.029*

*P values < .05 are deemed to be statistically significant.

the time schedule of the simulation training. In fact, and in addition, the instructor can use the T-NOTECHS as a structured recall tool in debriefing situations.

In our data that was collected during the spring of 2013, there were 22 trauma teams that included 109 participants. Analyses (paired sample T-tests) revealed that when comparing the means of all of the teams, each of the tool's five domains' means were higher after the second simulation, and four of them were statistically significant (Table 1).

Benefits and deficits of self-assessment

In medicine and nursing, the development of expertise requires the recognition of one's capabilities and limitations (Ward et al., 2003, 521), and an accurate assessment is imperative for learning, feedback, and progression (Arora et al., 2011, 500). Self-assessment of one's own abilities has been demonstrated to be challenging. For example, Arora et al. (2011) found in their study that surgeons were able to accurately self-assess their technical skills in virtual reality laparoscopic cholecystectomy. Despite that, formal assessment with a more experienced colleague was required for non-technical skills, for which surgeons lack insight into their behaviors. Among the physicians, a key concern seems to be that, on the whole, there is a tendency to overestimate one's own performance. In addition, a review highlighted that physicians are inaccurate when assessing their abilities when compared with objective external measures (Davies et al., 2006).

To improve the accuracy of self-assessment, the results obtained should be complemented by objective measurements, such as knowledge tests and observation, when possible. Additionally, when a peer or a teacher evaluates the individual's competence with the same tool/scale at the same time, the self-evaluation of competence can be completed and evaluated critically.

Video recording is also a valuable tool enabling objective assessment of the person's or team's performance. It has been recognized that the debriefing situations after simulations improve learning, and the ability to use video recording brings its own benefit to education because self-observation of videotaped performances have been demonstrated to improve the ability to self-evaluate (Ward et al., 2003). In our trauma-team simulations, the training is video recorded and videos are utilized in debriefings. However, these videos are used only in these debriefings, and they are not meant for or used for research purposes so as to maintain participants' anonymity and confidentiality during the training. To reiterate, trauma-team simulation training in our hospital is used as a regular teaching and learning method to improve and maintain the team's performance—not to evaluate team's competency.

Consequently, some studies report poor correlation between self-assessments and expert assessment scores, whereas others report higher correlations, implying the appropriateness of self-assessment (e.g. Ward et al., 2003). Despite these conflicting results, it is, however, important to develop an individual's capabilities to self-evaluate his/her own competence. Incompetency, overconfidence, and an inability to recognize the limits of one's own competency may endanger patient care. Within this perspective, self-assessment is also an important form of quality assurance that may potentially help improve patient safety, reducing errors in patient care.

Despite this varied and partly contradictory information about self-assessment as a method to obtain reliable and accurate results, the benefits of using the structured or semi-structured questionnaire as a tool for collecting information about learning outcomes are obvious.

Discussion

Reduced resources in the national, municipal, organizational, and occupational levels necessitate that the education for health care professionals is effective: It is no longer ethically and economically acceptable to arrange education that has not proven to be useful at least in some way. In addition, simulation as a method of teaching and learning is expensive, and resource demanding, so it is justifiable that the learning outcomes are examined and reported at the organizational level.

To conclude, randomized controlled trials of high quality studying the effectiveness of the trauma-team simulation training are still lacking. Currently, we are facing the same problematic question without an accurate and univocal answer, as do other educators, heads of hospitals, and researchers worldwide: How to reliably measure—and with what methods and indicators—the effectiveness of simulation training despite confounding factors. Meanwhile, this question remains unsolved, and we would encourage examining the effects of simulation training on the improvement of professional knowhow by combining innovatively and daringly different kinds of data-collecting methods. Our experiences are very encouraging, as the results of the self-assessments and the expert rater's evaluations concerning the learning outcomes after trauma-team simulation training are both parallel and show a significant improvement in non-technical skills. For us, this is a sign that we are going in the right direction.

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Simulation Team Training in Neonatal Medical Emergencies

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Outside university hospitals, the number of severe pediatric emergencies is low. Therefore, the staff in the minor hospitals might benefit from simulation training in these rare but very stressful situations. Simulation training has been found to be an effective tool with which to modify safety attitudes and teamwork behavior in pediatric emergency departments (Patterson et al., 2012).

Simulation training is an effective learning method; however, it needs many resources and it is quite an expensive way to teach. The effectiveness of the simulation training can usually be improved by increasing the time spent on simulated patient cases, but this can be restricted by lack of time or personnel. Some simulation courses offer pre-reading material and expect the trainees to absorb the knowledge just by reading it themselves. If learning is not controlled, the result of self-learning can be quite disappointing. In any case, clinical and non-technical skills need at least some hands-on practice. It would be cost-beneficial to find some novel methods to intensify simulation training without increasing the number of case-training episodes.

The project team formation and the simulation-training course

In this project, we formed a multidisciplinary team of specialists to develop training and to apply suitable aids to teaching and learning teamwork skills during simulation. Medical aspects of the training were planned by a neonatal pediatrician and a pediatric anesthetist with subspecialties in emergency medicine. The simulator operator was a former intensive care nurse with excellent technical knowledge of simulation systems. Educational knowledge for the group was offered by an educationist, with ongoing doctoral studies in the field of cognitive science and simulation in healthcare. All team members were simulation instructors with several years of experience. The group was led by the professor of anesthesiology at Helsinki University.

Simulation training is an excellent way to teach teamwork with healthcare professionals. Implementation of simulation training at the workplace (*in situ*) needs careful planning in order to fulfil the learning goals and to be as effective as possible. In this project, a novel and structured way to teach simulation team training in newborn emergencies was developed and implemented:

1. The whole training started with two 45-minute lectures about neonatals and child resuscitation for the hospital and pre-hospital staff members.
2. The simulation session of each test group started with 20 minutes of teamwork; a lecture about Anesthesia Crisis Resource Management principles (Rall & Lackner, 2010). So the basic knowledge regarding teamwork, decision making, and human errors was offered to the test groups before any simulation sessions.
3. Next, the multidisciplinary group of doctors and nurses participated in a simulation of two newborn emergency cases.
4. The test group participants' attention was focused on the teamwork principles with a self-assessment form. This self- assessment form was implemented to help trainees to assess their own performance and to concentrate on non-technical issues during the training. This form was filled in after each simulation case before the debriefing within the test group.
5. A structured debriefing was held after each case. Debriefing covered both medical and non-technical issues.
6. A structured debriefing form was developed to help instructors to observe teamwork and to run the debriefing in a similar way with all the groups.
7. After the last training session, one 60 minute Anesthesia Crisis Resource Management System- lecture (Rall & Lackner, 2010) was held to give the theoretical background about non-technical issues and to create a synthesis of the entire simulation training.

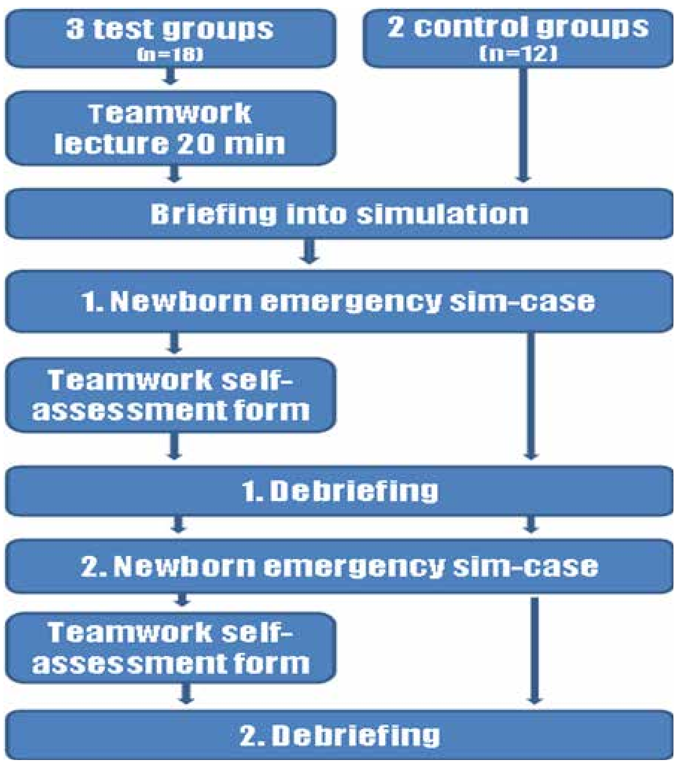

Figure 1. The simulation training protocol during the first training.

The training program was controlled in a study

The effectiveness of the new teaching system was compared to control groups with standard simulation training and debriefing:

1. The main purpose was to study if, in addition to focused simulation training, a 20-minute teamwork lecture and a self-assessment-task can guide trainees to adopt teamwork ideas more quickly. The control groups received standard simulation training without any additional teaching and learning support.
2. Secondly, the retention of teamwork skills after a four-month period was studied. There are indications that long-term skill retention requires deliberate and repeated practice (Ericsson, 2004).
3. Besides the practical simulation training itself, debriefing is crucially important in facilitating learning during simulation-based training (Dieckmann et al., 2009). Thus, the third aim of this study was to develop a structured assessment form to help instructors during debriefings.

The course timetable and content

The evaluation of these simulation trainings with and without extra teaching was held in a central hospital in September 2012 and January 2013. The chosen hospital was suitable for the training program implementation because the incidence of newborn emergencies was low, the distance to the university hospital was long, and the staff was not so familiar with the simulation training. This hospital was also quite suitable for the study purposes, as the same staff members could be recruited for the training for both study periods.

Our simulation-training program was targeted at multidisciplinary teams treating newborns. The entire staff of the pediatric ward participated. Three test groups and two control groups were created (see Figure 1). The protocol was repeated after a four-month period.

There were two medical doctors and four nurses or midwives in each group; thus, a total of 30 professionals were trained. There were two simulation sessions on one day for each group. After a four-month period, this same setting was run again but without resuscitation or teamwork lectures. Some changes in the staff had occurred, but about 80% of the test and control group persons were still the same.

Assessment of the training

Team performance evaluation plays an integral role in ensuring that simulation-based team training (SBTT) is systematic and effective (Rosen et al., 2010). In this project, much effort was put in to ensure that there was a high-level, standardized evaluation:

- A normal debriefing by two instructors was held for every group after each simulation session.
- The medical and non-technical performance was discussed with a pre-planned system in a constructive way.
- There was a time limit for the debriefing, and teamwork issues were covered with a list based on CRM and the anesthetists' non-technical skills (ANTS) system principles (Flin et al., 2010 & 2012).
- Every training session was video recorded and the teamwork effectiveness was assessed from the videotapes separately by three outside experts with a TEAM evaluation form (Cooper et al., 2010).

During the first and second study sessions, a structured debriefing form with instructive guidelines based on CRM and ANTS principles was developed and tested. The debriefing form was aimed at being a tool for instructors to bring structure into the debriefings and to standardize debriefings between different teams and instructors. During the first session, the preliminary version of the form was tested by the two instructors, and based on the results, the form was modified. The first version proved to be too full of items, so the next version was shortened, and the space for narratives was increased.

Results of the study

The results of this project showed the effectiveness of the multidisciplinary simulation team training *could be improved* by a short teamwork lecture and a self-assessment task.

Teamwork performance

TEAM total points, which reflect the overall teamwork performance, improved faster with additional teaching and learning aids than without them between the first and second simulation sessions on the first day. The overall performance of the staff was on a professional level right from the start, and the teamwork performance was at a high level already in the first training session. The entire staff participated eagerly in this project and their attitudes were positive regarding the simulation training (see Figure 2).

- The scale runs from 0 (*teamwork component not happening at all*) to 4 (*happening all the time*).
- Teamwork scores improved clearly between case 1 and case 2 in the additional teaching and learning aid group (blue), but not in the control group (green).
- The retention of the teamwork scores was not better than at the baseline (case 3 vs. case 1) after the four-month period.

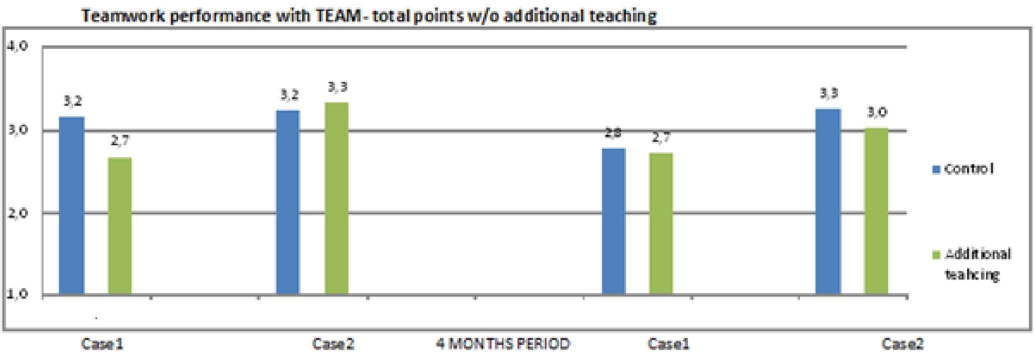

Figure 2. The graphics of the results.

Retention of the training

Retention of the teamwork skills after the four-month period was disappointing, but even this was to be expected considering the previous studies in the literature. After the four-month period, the TEAM total points had returned to the level of the first simulation session. There had not been any severe neonatal emergency cases between the simulation trainings on that ward. Clearly, simulation training alone every fourth months is not enough to keep up with or improve teamwork skills if there are no real patient cases in the interim.

Transfer into work

However, practical working methods in daily clinical practice had improved clearly with simulation training, even though the teamwork skill retention was not so good. Practical work was assessed from the learners' written opinions and it was seen in praxis during the second SBTT session after four months. The training revealed several system problems, which were not only noticed and listed to, but also corrected rapidly by the ward staff. These improvements are usually not measured in studies; however, they can be more important in daily practice and for patient safety than the usually measured values.

Debriefing

Multidisciplinary SBTT debriefing is a demanding challenge for the instructor. Instructors' concentration is divided by medical and non-technical-skills performance, team spirit issues, and by many different professions and personalities. During this project, this debriefing task was divided between two instructors: one was assessing the medical correctness and the other one concentrated on non-technical skills.

The debriefing form developed for the instructors was found to be quite complicated. It needs modification and further testing in order to function in demanding multidisciplinary simulation training. To resolve challenging debriefing situations, an instructor assessment form could be one option to standardize the sessions. These learning and training tools should be developed from a multidisciplinary perspective, combining clinical and educational expertise.

Summary

Simulation training is effective but expensive. In remote hospitals, training possibilities and real emergency cases are sparse. Simulation training to teach teamwork in neonatal emergency situations for hospitals was developed. The new way to train was compared to the standard simulation training. Some clear conclusions were made:

1. Additional teaching and use of learning aids in SBTT had a positive impact on teamwork skills in the first simulation session.
2. This impact was not seen after a four-month period. In small-volume hospitals, a four-month period between training is not sufficient to maintain the practiced SBTT skills.
3. SBTT revealed several system problems on the ward, which were listed and corrected. These improvements are usually not measured in studies; however, they can be important in daily practice and for patient safety.
4. Debriefing is a demanding task during a multidisciplinary SBTT. A standardized form could be a valuable tool to help instructors to run debriefings in a more structured and standardized way.

Simulation training for the entire ward staff in the workplace in situ is a unique way to change attitudes and working habits toward safer patient care. Currently, it is common to focus on solely measuring how simulation training has improved the technical or non-technical skills of a person or a group. In this project, however, simulation training helped to reveal and eliminate some important risk points in terms of patient care. Improvements in everyday working practice were made, even though this does not show up in any studi es or measurements. This system improvement through simulation training is a great target for further studies.

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