Conditions for learning in simulation practice:

training for team-based resuscitation in nursing education

by

Sissel Eikeland Husebø

Thesis submitted in fulfilment of
the requirements for the degree of
PHILOSOPHIAE DOCTOR
(PhD)

University of
Stavanger

Faculty of Social Sciences
Department of Health Studies

2012

University of Stavanger
N-4036 Stavanger
Norway
www.uis.no

ISBN: 978-82-7644-506-0
ISSN: 1890-1387

PhD thesis no. 173

Acknowledgements

Writing a thesis is like travelling on 'a long winding road'. Along the way, I have met many people who have inspired me to go further and not stop off. The journey started when the SAFER simulation centre opened in 2006. I went into the world of simulation, excited about the learning possibilities the tool could offer nursing students. In 2007 the opportunity came to do a study on simulation in nursing education and I started on this challenging but interesting work. Many people have in many ways been helpful and supportive.

Firstly I want to thank my main supervisor, Febe Friberg at the University of Stavanger, for her support, guidance and feedback through the entire process, and for sharing her knowledge and experience. I am also deeply grateful to my two assistant supervisors, Hans Rystedt, University of Gothenburg and Eldar Søreide, Stavanger University Hospital for valuable contributions and constructive feedback on all my work. A special thanks goes to Hans for opening the door and organizing my research stay as a visiting PhD candidate at the University of Gothenburg in 2009. I would also like to thank Peter Dieckmann and Conrad Bjørshol for their commitment and contributions to two of the articles.

I am very grateful for the generosity of the facilitators and nursing students at the University of Stavanger, Department of Health Studies who have been so kind in letting me observe and video-record their activities. This thesis would not have been written without their willingness to participate. A special thank you goes to my colleagues Marit Vestersjø and Eli Bøe for their support and generosity throughout the project period.

Thanks also to all of my colleagues and fellow PhD candidates at the Department of Health Studies and SAFER for interesting discussions and encouragement. A special thanks to Anita Shenoi for her good work in language revision, and to the Laerdal Foundation for Acute Medicine for providing financial support for the study.

Last but not least, I am very grateful to my family, who has put up with an absent minded mother and spouse for far too many years. A special word of thanks goes to my sons, Torstein and Tormod, for reminding me of what is important in life, and for all their support in using computer software. I am proud to say that Tormod did the drawings in two of the papers included here.

In memory of my mother, who died from a cardiac arrest in 2005

Stavanger, April 2012

Sissel Eikeland Husebø

Summary

Background: Research demonstrates that simulation-based learning in nursing practice is a promising educational method used under appropriate conditions. Research using simulation for performing resuscitation in nursing education has been mainly concerned with the goal of justifying its use or proving that it works, while less effort has been devoted to understanding the complexity inherent in those activities.

Aims: The overarching aim of the study was to develop knowledge about the critical conditions for learning team-based resuscitation in simulation-based learning environments. This aim involves an interest in how simulation can provide an arena for nursing students' participation, how simulators can function as mediating tools for learning, and how social order is established and accounted for in simulations.

Theoretical framework: Simulation practice in this thesis is studied within the socio-cultural perspective. The socio-cultural perspective views learning as taking place through participation in activities in interaction with others and artefacts.

Methodology: In 2008, a total of 81 nursing students studying in their last semester of a three-year nursing education program participated in the study. The nursing students were divided into 14 groups, each of which comprised between 4-7 members. Five faculties participated as facilitators in the study. Data were generated by means of video-recordings from 14 briefings and 28 simulation scenarios and debriefings. Interaction analysis was used to analyze the briefing and simulation scenarios, whereas content analysis was used to analyze the debriefings. Several statistical procedures were applied to analyze the nursing students' D-CPR performance in the simulation scenario.

Results: In paper I the interaction analysis of the briefing revealed that four conditions are of particular importance for learning in simulation practice: a) to bridge between simulation practice and clinical practice in the briefing; b) only include skills learned in advance and in line with the specific educational level in the simulation scenario; c) provision of repetitive practice and feedback in simulated D-CPR performance, and d) secure reflection in the debriefing. In paper II the interaction analysis identified three phases of coordination in the resuscitation team: Stating unconsciousness, Preparing for resuscitation, Initiating resuscitation. The students' coordination of joint assessments and actions in these phases involved a broad range of verbal and nonverbal communication modes that were necessary for achieving mutual understandings of how to continue to the next step in the D-CPR algorithm. In paper III, a theory-driven content analysis of the facilitators' questions and the nursing students' responses demonstrated that facilitators mostly asked descriptive and verifying/confirming questions, while nursing students mostly responded with descriptive replies. Nevertheless, the facilitators' descriptive questions also elicited student responses on a more reflective level. In paper IV, the statistical analysis demonstrated that there were large variations in how accurately the nursing student teams performed the specific parts of the D-CPR algorithm. None of the nursing student teams achieved top scores on the D-CPR-checklist. Further, the findings revealed that observing one simulation scenario and participating in the following debriefing did not improve the students' performance of D-CPR in a subsequent scenario.

Conclusion: This thesis has contributed to the understanding of what goes on in the 'black box' of simulation practice in nursing education. The study demonstrates that the simulation-based environment is a very complex one for the nursing students to master as they must deal with both the specific conditions in this simulation-based learning environment and the tasks to be managed in resuscitation. The results of the study point to several critical conditions that are important if the learning objectives in the simulation are to be achieved. Firstly, it is of vital importance that the facilitator's instruction does not lead to confusion regarding what the simulation is simulating. Secondly, it is important that guidance and correction of tasks is provided by the facilitator. Thirdly, to achieve coordination of resuscitation teamwork, the interplay between non-verbal and verbal communication modes must be trained and emphasized in the simulation. Fourthly, optimizing nursing students' reflection in the debriefing requires questions on a reflective level, and fifthly, accurately team-based D-CPR performance in nursing education requires repetitive practice and feedback.

Contents

Part I

A cardiac arrest scenario

In this thesis, the context chosen for studying conditions for learning is a simulation-based learning environment in nursing education, in this case concerned with nursing students' participation in simulated cardiac arrest scenarios. The following illustrates how the facilitator introduces the cardiac arrest scenario in the simulation to the nursing students and how the scenario proceeds. The facilitator starts the scenario by saying: "The patient is a 71 year-old woman who has suffered an upper femur fracture and has been moved to an out-of-hospital rehabilitation unit. The patient has a history of angina pectoris and is now complaining about chest pain. Your team are now required to take care of this patient." The simulation starts with the nurse entering the room to see if the patient has finished breakfast. "Good morning, Mrs Nielsen, my name is Clare and I am the nurse responsible for you today. How are you this morning?" "Not very well, I haven't eaten anything for breakfast", Mrs. Nielsen answers. Mrs. Nielsen, the simulated patient now complains "I feel short of breath and have a pain in my jaw". Nurse Clare starts monitoring vital signs and calls her peers for assistance. She connects the oxygen, and when her two colleagues show up she updates them on the patients' health status and gives directives: "Ken, call 113". Suddenly Nurse Clare discovers that Mrs. Nielsen is unresponsive and is not breathing. She calls out "We have a cardiac arrest, Laura- can you pick up the defibrillator, backboard and emergency kit in the corridor? Ken, start chest compression". Nurse Barbara positions behind the head of the bed and starts to ventilate the patient with a bag-mask. Nurse Laura arrives with the medical devices, attaches the pads on the patient's chest and says with a clear voice "all away from the bed" and then pushes the red shock button. After some minutes of cardiopulmonary resuscitation, Mrs. Nielsen wakes up, complaining of chest pain. The scenario closes with the arrival of the 'paramedic', who asks for an update on the patient.

1 Introduction

Higher education contributes to developing society and to social change (Ramsden, 2003). An important prerequisite for this to happen is that higher education is research-based and that the pedagogical methods applied in higher education fulfil the demands of educating highly competent professionals. Nursing education as part of higher education is no exception. A change from pedagogical methods focusing on transfer of knowledge to students as active participants in the learning processes is described by several authors nationally and internationally (Bassendowski, 2007; Brown et al., 2009; Dysthe, 2001). The reasons for the changes in the pedagogical methods are partly due to development of the society that nurses serve (Jensen, 2006; Kantor, 2010) but also to the fact that students today expect a more learner-centred, hands-on approach in education (Alinier et al., 2006; Medley & Horne, 2005). This change has involved, among other things, a shift from traditional teaching towards more innovative learning strategies involving student-centred learning and new technology such as computer-based patient simulators (Brown, et al., 2009; Stanley & Dougherty, 2010).

In Norway, like in many other countries, authorities and employers expect nurses to have necessary competence[1] to perform nursing. The six core competencies identified as necessary for several healthcare professions, including nursing are: provision of patient-centred care, employment of knowledge-based practice, teamwork, application of quality improvement, utilization of informatics and provision of safe care (IOM, 2003). The core competencies are also relevant for nursing education. Since the Institute of Medicine report "*To Err is Human*" was released in 2000, there has been a growing interest in patient safety issues in the field of healthcare. The alarming rise in morbidity and mortality among hospitalized patients throughout Europe and USA has heightened concerns about professional

[1] Competence is defined as a description of an action, behaviour or outcome that a person should demonstrate in their performance (McMullan et al., 2003).

competency and highlighted simulation[2]-based learning as an important tool in improving patient safety (Kohn et al., 2000). Likewise, nursing education programs are faced with increased pressure to produce graduates who are capable of providing safe patient care. In spite of this trend, studies in nursing practice have shown that recently graduated nurses do not have the required competence in emergency care, resuscitation, leadership and communication (Hamilton, 2005; Madden, 2006; Mullan & Kothe, 2010; Vareide, 2001). Nursing education as part of higher education must prepare students for knowledge-based practice (QSEN, 2005), skills in knowledge dissemination (McNamara, 2010) and patient-safe healthcare practice. This presumes innovative pedagogical methods.

Preparing nursing students to be skilled professionals is a pedagogical challenge (Mekki & Tollefsen, 2000), partly due to concerns about limited time for training, increased competition among healthcare education providers for clinical placements, and a desire to provide specific clinical experiences for students (Nagle et al., 2009). In this respect, there has been a growing interest in simulation-based learning (ibid.). Research in simulation-based learning has demonstrated that the method is student-centred and interactive and is beneficial in preparing students for real-world patient care experiences (Alinier, et al., 2006; Bremner et al., 2006), teaching nursing students' skills, and improving their knowledge, critical thinking and confidence (Cant & Cooper, 2010).

One core competency in nursing is the ability to work in teams (IOM, 2003) and to master emergency situations like cardiac arrest (Madden, 2006). Nurses are expected to respond properly to cardiac arrest situations, both inside and outside hospitals (Davies & Gould, 2000; Hamilton, 2005; Madden, 2006). The Norwegian Health Personnel Act (no. 64, 1999, section 7) confirms nurses' duty to "immediately provide the medical care they are capable of when it must be assumed that the assistance is urgently required". This provision implies that nursing students have a legal obligation to provide life-

[2] By simulation I mean the activity in which one or more participants are interacting with a simulator (Lindblad, 1976)

saving treatment like defibrillation and cardiopulmonary resuscitation (D-CPR) to patients when required.

Nevertheless, numerous studies have demonstrated that nursing students, as well as registered nurses, have poor retention, knowledge and skills in performing resuscitation teamwork after training in resuscitation (Badger & Rawstorne, 1998; Hamilton, 2005; Hammond et al., 2000; Madden, 2006). One way to achieve the necessary competence in resuscitation is to base resuscitation education and training on current guidelines in using simulation of cardiac arrest scenarios (Hamilton, 2005; Hravnak et al., 2007). According to Leighton and Johnson-Russell (2010), patient care during cardiopulmonary resuscitation and practicing high-risk technical procedures such as defibrillation rarely occur in everyday practice. Moreover, it is not possible to train these skills on live patients due to ethical reasons and the risk of unacceptable consequences (Decker, 2007). Since patient care is all about taking care of and maintaining the patient's life and health in an optimal way (ICN, 2011), (a central assumption and value in the nursing profession), learning how to perform resuscitation in nursing education is a vitally important field to study.

1.1 Aim of the study

The overarching aim of the study was to develop knowledge about the critical conditions for learning team-based resuscitation in simulation-based learning environments. This aim involves an interest in how simulation can provide an arena for nursing students' participation, how simulators can function as mediating tools for learning, and how social order is established and accounted for in simulations. The knowledge developed in the study is expected to contribute to the development of design of simulation practices and enhance possibilities for nursing students to transform knowledge and skills to communities of clinical healthcare practice. The four specific aims related to each of the four papers in Part II of the thesis is formulated below.

Paper I. An important condition for serving the simulation objectives in nursing education is that instructions during the briefing function as a bridge between the simulation and the real situation it simulates. A simulation can be understood in many ways and impart different meaning to different participants, something that must be taken into account in the design, preparation and presentation of each scenario (Dieckmann et al., 2007). This ambiguity of simulation implies a complexity in understanding and acting from the perspective of the participants (Rystedt & Lindwall, 2004). Despite the provision of comprehensive instructions, it is not certain that nursing students understand which aspects of real clinical situations the simulation is supposed to replicate (Bailey et al., 2010). For these reasons, the instructions of the facilitator in the briefing are important to further explicate the relation between the simulation's incomplete representation of reality and the real clinical situation that the simulation is supposed to mimic (Bailey, et al., 2010). This leads to the aim of **paper I** which was:

- To explicate instructional problems in the briefing, focusing on how nursing students understand that actions should be performed in resuscitation teams and how these actions should be adapted to the specific conditions of the simulation.

Paper II. Verbal communication is considered essential for effective coordination in resuscitation teams (Cooper & Wakelam, 1999; Grote et al., 2004). Kyrkjebø et al. (2006) claim that team training is seldom offered in the nursing education curriculum. Although simulation is a promising method for improving coordination skills, previous studies have overlooked the necessity of addressing the multifaceted interplay between verbal and non-verbal communication modes. More research is needed to identify the conditions necessary for the development of successful coordination in simulation settings (Manser et al., 2008). The research interest in this study is extended to non-verbal modes, such as gestures and body movements, and the team members' efforts to coordinate their actions in a simulated cardiac arrest scenario in nursing education. The aim of **paper II** was:

- To explore and describe the interplay of communicative modes nursing students employ to coordinate the team in a simulation-based environment designed for resuscitation team training.

Paper III. In simulation, reflection in the debriefing is identified as the most important feature of simulation-based education across different professions and disciplines (Issenberg et al., 2005; Parker & Myrick, 2010). Despite the educational importance of the debriefings for promoting reflection in simulation, questions concerning how to debrief and what to debrief to promote nursing students' reflection have received little attention in the simulation research literature (Dreifuerst, 2009; Fanning & Gaba, 2007). The aim of **paper III** was therefore:

- To explore the practice of debriefing with a focus on conversations between facilitators and nursing students about leadership in resuscitation teamwork.

Paper IV. Although nursing students must be able to respond quickly and effectively to cardiac arrest, research has demonstrated poor performance (Badger & Rawstorne, 1998; Hammond, et al., 2000; Madden, 2006). Simulation is a promising learning tool for resuscitation team training but there are few studies that examine simulation for training defibrillation and cardiopulmonary resuscitation (D-CPR) in teams from the nursing education perspective. The aim of **paper IV** was:

- To investigate the extent to which nursing student teams followed the D-CPR algorithm, and to examine if observing one simulated cardiac arrest scenario and participation in one debriefing could improve team performance of D-CPR in a subsequent simulation.

1.2 Outline of the thesis

The thesis consists of two parts. Part I covers seven chapters. After an introduction of the overall theme and aim of the study, the second chapter presents simulation for learning purpose. Chapter 3 outlines previous research in the field and Chapter 4 is about the theoretical perspective relevant for the study. Chapter 5 describes the methodology and Chapter 6 reviews the results from the four papers. Chapter 7 discusses the results and outlines methodological reflections, implications for educational practice and suggestions for future research. The four papers are presented in Part II.

2 Simulation for learning purposes

2.1 Historical outline of simulation

During the 1940s and 1950s, nursing education shifted from a hospital-based apprenticeship model to collegiate programs. Nursing skills laboratories were created to help students apply the theory learned in the classroom prior to facing the challenges presented by the clinical setting. At the same time, tremendous advances in patient treatment technology were occurring. The first resuscitation guidelines were developed, and the external defibrillator was invented. Providing patient care held new challenges for nurses, and they needed to be better prepared to face such challenges (Hovancsek, 2007). To meet these demands, the nursing schools established clinical skills facilities for clinical preparation practice. According to Bradshaw and Merriman (2008), the rationale for setting up skills laboratories in the UK was to bridge the theory-practice gap and respond to criticisms that newly qualified nurses lacked clinical skills.

The use of simulation in nursing education is not a new teaching tool; nurse educators have used role play and static mannequins to simulate patient situations for decades (Overstreet, 2008). For example, various skills trainers have been used in the development of individual nursing skills (Nehring et al., 2002). What is new is the development of advanced computer technology that can be used for educational purposes in acute and critical care, emergency nursing situations (Bailey, et al., 2010), team-oriented training, (Cannon-Diehl, 2009) communication (Pagano & Greiner, 2009) and patient safety (Nehring, 2010). This was enabled through the development of technology along with a shift to more learner-active pedagogical methods. Moreover, Bassendowski (2007) points to the fact that the millennial generation nursing students expect cutting-edge technology to be integrated into their educational programs. Skiba (2007) argues that this generation prefers pedagogy based on teamwork, familiarity with the process of learning, and opportunities for increased realistic immersion. According to Parker and Myrick (2009) simulation can fulfil these needs. In addition, Grif Alspach (1995) suggests that simulation-based education can be used when direct clinical experiences might be difficult to provide, when it could be ethically troublesome, or when extraneous factors cannot be controlled to ensure an optimal learning experience.

2.2 What is simulation?

The concept of simulation has been widely applied in a great number of practices (Lindblad, 1976) and in areas like the military, aviation and nuclear power (Bradley, 2006). Numerous definitions of the concept exist, but in this section I will explain the definitions that are relevant to clarifying how the concept of simulation is applied in this study. Bennet (1995) describes simulation as an art, a technique or a methodology for modelling some particular dynamic aspect of a specific system, with the explicit purpose of understanding the simulated system. In this study, simulation as an art is excluded. The system can represent something real, such as flight-simulators, or something proposed, such as role-playing games (Greenblat, 1998). Simulation consists of two entities: 1) something that has to be simulated, or an abstract system, such as the human physiology, and 2) a theoretical model where different parameters are related to each other (Lindblad, 1976; Rystedt, 2009). These two together are called the simulandum (Lindblad, 1976). Also required is a simulation program that somehow calculates the dynamics of the model: the simulans. The simulans would be the artefact or the simulator, combined with the room and equipment in which it is situated. There is no simulator that constitutes the simulation, but rather someone's interaction with the simulator (ibid.).

In order for a patient simulator to become a simulation it requires that the simulator is integrated and used in an activity. Johnson (2004, p. 23) points out that it is therefore important to distinguish between the terms simulator and simulation:

> There is a difference between a simulator and a simulation. I use the term 'simulator' to mean the thing upon which the practice is enacted. To be turned into a 'simulation', a simulator needs to be enacted upon, incorporated into action.

When the term 'simulation' is used in the following it refers to this understanding of simulation.

2.2.1 *The phases in simulation*

The simulation for team training is generally divided into four phases (Dieckmann, 2009): planning/preparation, briefing, simulation scenario and debriefing, as described in detail below (Figure 1).

Figure 1. The phases in simulation

Planning/ preparation	Briefing (15 min.)	Simulation scenario (10-15 min.)	Debriefing (20-30 min.)
Identifying: - learners -learning needs and objectives -group size -time frame	Introducing the: -room -equipment - patient simulator	Participating in the simulation scenario	1.Describing 2.Analyzing 3.Application

The planning/preparation

The simulation needs planning and preparation like other educational methods (Lau et al., 2010); such planning includes identifying learners, learning needs, learning objectives, group size and time frame. Before identifying the learning objectives, the educator is recommended to review the educational taxonomies that define these objectives by asking questions concerning what domains the learning objectives should include, for example the cognitive, the affective, and the psychomotor. Information regarding learning objectives, a short description of the case scenario (description of the patient situation), and sources like book chapters or articles have to be available to learners prior to the simulation. A well-written scenario addresses the intended learning objectives, the delivery of care and the overall integration of skills, including communication, that takes place during the enactment of the scenario (Lau, et al., 2010). A simulation scenario usually includes nursing skills that must be executed, not in isolation, but as a part of the total care of the patient. Several components adapted to the students' level can be added, such as administration of drugs and communication with the physician via telephone (Bailey, et al., 2010). Bailey et al. (2010, p. 218-19) have described a seven-step process for the development of the simulation session:

1. Determine educational objectives
2. Construct a clinical scenario to facilitate attainment of educational objectives
3. Define underlying physiologic concepts to be manifested throughout the scenario as they relate to the patient's responses to various events as they occur
4. Modify programmed patients and scenarios, as necessary
5. Identify required equipment
6. Run program and collect feedback
7. Reiterate steps until satisfied

The briefing

In the briefing, learners are introduced to the activity, the learning objectives, the roles, the simulation facilities and the medical equipment available. The briefing serves as an orientation prior to the simulation experience (Figure 1). It focuses on two factors: (a) the background, roles, tasks, and environment of the scenario and (b) specific instructions for participating in the simulation (Hertel & Millis, 2002). During the briefing, the facilitators introduce the patient simulator and the equipment in the simulation room, e.g. oxygen, airway devices, and the bed. The learners are instructed as to which procedures can or cannot be performed on the mannequin, how to execute these procedures, and how these are different from those performed on a human being (Bailey, et al., 2010). The facilitator informs the learners about learning objectives, the patient's health situation and rules to apply, i.e. that they have to speak to the patient simulator as they speak to a patient and that all care, treatment and medication have to be executed. The learners are informed about confidentiality and of the fact that the simulation scenario is video-recorded.

The simulation scenario

The simulation scenario provides the experience episode, which can later be debriefed. The scenario is of a certain length and takes place in a special simulation area, e.g. emergency care or a rehabilitation unit. The learners are engaged in the simulation activity, which has a relationship to the learning objectives. As a learner in the scenario, he/she may need to be a participant in multiple roles, depending on the activity and the objectives of the course. As the simulation continues, students see the results of their interventions and the impact on the patient’s condition (Leighton & Johnson-Russell, 2010).

The debriefing

After each simulation scenario, the learners take part in a debriefing, guided by the facilitator analyzing team performance in relation to the learning objectives. *Debriefing* refers to

> the purposeful, structured period of reflection, discussion and feedback undertaken by learners and teachers usually immediately after a scenario-based simulation exercise involving standardised patients and/or mannequins (Flanagan, 2008, p. 155).

The purpose of the debriefing is to provide an opportunity for the learners to explore their own and others’ practice with respect to the objectives of the session and promote reflection-on-action and planning for different ways of handling the event in clinical practice (Flanagan, 2008). The debriefing provides the appropriate time and occasion for reflecting on what the students felt, thought and did, the relationship between their actions and responses, and how they could apply their new insights in future patient situations. According to Johnson-Russell and Bailey (2010, p. 373) learners who question what they could do differently tend to be better practitioners in the future. Throughout the debriefing process, focus must be given to students’ performance as both individuals and team members, as well as to the patient's condition, interventions applied and responses. In addition, questions about how students communicated and how they provided assistance from other team members can promote reflection. Flanagan (2008) states that it is generally agreed that there are three phases in the process of debriefing. Firstly, the descriptive phase attempts to elicit the participants' feelings and has them describe what happened in the scenario. In the second phase, the issues concerning what was done well and how things might be done differently are explored. Thirdly, in the application phase, the students consider how they can apply their new insights in clinical practice.

2.2.2 *The roles of the faculty in simulation*

Facilitator

A faculty member of the nursing program can serve as a facilitator. According to Moyer et al. (2007), he/she does not directly instruct the learners what they need to do, but provides the objectives for the collaborative learning object. Leighton and Johnson-Russell (2010) propose a more nuanced view, suggesting that the facilitator role is dependent on the educational level of the students. Novice students, for example, may experience stress or anxiety when placed in an unfamiliar environment to care for a simulated patient. The facilitator can therefore instruct bedside, and respond to any questions they ask before the onset of the simulation scenario. The responsibility of the facilitator includes creating a safe learning environment, helping the students to reflect on the simulation experience and providing feedback on their performance (Hertel & Millis, 2002). The facilitator role may imply switching between instructing and facilitating students when appropriate e.g. in the briefing and debriefing. The facilitator is present in the simulation room during the simulation scenario to observe the performance and provide information about simulator changes of, for example skin and pupils. The role of the facilitator in this phase is to ensure that the scenario does not develop in the wrong direction.

Simulator operator

One of the faculty staff can serve as the simulator operator. He/she is responsible for activating the simulation system, starting the patient software, overlaying the clinical scenarios, monitoring the progress of a scenario, and adjusting the scenario as the facilitator intended it to be.

2.3 Technological development of simulators

The first simulators used in healthcare education were anatomic models for teaching the anatomy and physiology of the human body. In the USA, Mrs. Chase was the first prototype mannequin used by nursing programs in the late 1950s. The mannequin was used in classroom demonstrations with the intention of allowing nursing students to individually practice nursing skills without causing possible discomfort to patients (Lashley & Nehring, 2010; Nehring, et al., 2002). The next decade saw the introduction of the Harvey model with heart and lung sounds to enhance learning and training. In the early 1960s, the Laerdal Company in Norway developed “Resusci-Anne” for training resuscitation skills. Learners were able to perform and train ventilations and chest compressions on this static mannequin. “Resusci-Anne” is still in use.

The first studies on the use of advanced patient simulators in nursing education were published in the end of the 1990s (Nehring, et al., 2002) highlighting the advantages and disadvantages of the use of advanced patient simulators in nursing programs and scenario development. In 1998, several studies appeared using simulation in education of nurse anaesthesia students (Fletcher, 1998; Monti et al., 1998; O'Donnell et al., 1998). The computerized simulation mannequins were first developed for training in schools of anaesthesiology to enhance competency and reduce errors in the administration of anaesthesia. In nursing education, advanced life-sized computerized patient simulators have been used for roughly a decade (Lashley & Nehring, 2010).

2.4 Simulators in nursing education

There are various types of simulators used in nursing education.

Static models or task trainers primarily made of rubber body parts are used for the practice of clinical skills such as urinary catherization and basic life support (Seropian et al., 2004).

Full-body mannequins such as Laerdal's Nursing Anne with VitalSim capability are limited in the range of conditions they can simulate and provide limited feedback to users (Alinier, 2007; Seropian, et al., 2004). This kind of simulator has embedded software and is controlled by an external, handheld device and can be used to train skills such as auscultation of heart and breath.

Screen-based computer simulators, in comparison, are designed to model various aspects of human physiology or specific tasks or environments. Through a variety of computer programs, students are instructed to use information to make clinical decisions, observe the results in action and receive additional feedback afterwards (Alinier, 2007).

Dynamic life-sized computerized mannequins can mimic diverse parameters of human anatomical physiology and can respond physiologically to computer commands, which include pulse, breath sounds and speaking (Hyland & Hawkins, 2009).

Dynamic life-sized computerized simulators and screen-based computer simulators include three central base units (Rystedt, 2009). Firstly, it contains something to be simulated, such as a specific procedure or an abstract system (e.g. human anatomy). Secondly, the simulator contains a conceptual, computer-based model for which the different parameters are connected, e.g. pulses and blood pressure. Thirdly, the simulator contains a user interface that allows the user to interact and receive feedback from the model. The simulators are entirely different with respect to the user interface. Users can interact with the life-sized simulator through direct manipulations, while the screen-based simulator provides interaction through the computer mouse and keyboard.

The type of simulator we are concerned with in the present study is a computerized full-body mannequin of rubber and plastic that is capable of physiological responses, including respiration, pulses, blood pressure and heart sounds (Durham & Alden, 2008) (Figure 2). The users interact directly with the mannequin and the simulator provide responses to the participants' actions (Rall & Gaba, 2005; Rystedt, 2009), the blood pressure of the simulator rising, for example, when intravenous fluid is given.

Figure 2. The simulator

SimMan® manufactured by Laerdal Medical is an example of such a patient simulator and is used in this study. A speaker located in the head of the simulator transmits the voice of the operator, thus giving the impression that the 'patient' can talk. The simulator offers a variety of possibilities for nursing students, regardless of the level of their clinical abilities. They can palpate pulses, insert oral airway, monitor blood pressure, saturation and respiratory frequency, and chest heaves. The simulator can also be defibrillated. When the term 'patient simulator' is used hereinafter, it refers to this kind of simulator.

3 Previous research

The following chapter reviews previous research related to simulation-based learning in nursing education and practice, sources here comprising the international database, EBSCO host (Academic Search Elite, Educational resources Information Centre [ERIC] and the Cumulative Index of Nursing and Allied Health Literature [CINAHL]). The search was limited to peer-reviewed studies with abstract. The search terms: *simulation* or *high-fidelity simulation*, *nursing practice*, *nursing education* or *nursing students*, *resuscitation* or *cardiopulmonary resuscitation, conditions for learning* were applied in different combinations. In addition, reference lists and articles published in *Clinical Simulation in Nursing* and *Simulation in Healthcare* were checked to identify as much relevant literature as possible, with searches performed repeatedly until March 2012. Studies explicitly aimed at investigating the conditions for learning in simulation practice for other healthcare professions were also included. This review outlines the most significant outcomes from previous research on the use of simulations for learning purposes and provides a background for identification of the research problem addressed in this study.

3.1 Simulation in nursing practice

Cannon-Diehl (2009) explores the scope of simulation in healthcare and nursing, and aims to explain the use and limitations of simulation. The study recognized that nursing students have identified anxiety, lack of realism and access to the patient simulator as limitations of simulation. The findings demonstrate that simulations are built and will evolve on the basis of three major issues. Firstly, there is evidence that simulation as a learning strategy in any form is effective when used under the appropriate conditions for enhancing knowledge, skills, and pertinent professional and clinical behaviours. Secondly, simulation has been evaluated to be a viable teaching and learning strategy. Thirdly, however, adequate simulation resources related to technology and knowledgeable faculty have often been shown to be variable and limited. Barriers to the use of simulation by nurses, such as unease at being video-taped, unfamiliarity with the equipment and a perception of the environment as stressful have also been identified.

3.1.1 *Simulation of resuscitation in nursing practice*

Nursing research literature shows that simulation has been used to improve nurses' knowledge and skills in resuscitation (Carpico & Jenkins, 2011; Gordon & Buckley, 2009; Long, 2005). Studies have been most concerned with the effects of simulation in terms of improved resuscitation performance (Carpico & Jenkins, 2011; Gordon & Buckley, 2009).

One study (Carpico & Jenkins, 2011) evaluated the effect of simulation-based resuscitation education on nurses adherence to CPR-protocols at two healthcare units, the findings demonstrating that nurses in both units improved their performance after the educational program. Another study examined the effect of simulation on graduate nurses' perceived ability and confidence in responding to patients in clinical emergency situations (cardiac arrest) (Gordon & Buckley, 2009). The findings revealed increased confidence in nurses' ability to perform both technical and nontechnical aspects in clinical emergencies. Gordon and Buckley (2009) also identified the debriefing as the most useful aspect for learning from the simulation experience.

Some studies compare outcomes of different learning methods applied in simulations. One study (Granneman & Conn, 1996) compared two simulated mock code groups. One group demonstrating critical elements before participating in the simulated mock code, the other not. This revealed that both learning programmes led to similar levels of skills/knowledge retention and perceived satisfaction and both groups were shown to have similar knowledge and skills retention at 6 months.

One review (Hamilton, 2005) emphasises that the use of simulation to learn CPR should, among other things, include a variation of cardiac arrest scenarios. The study reviewed nurses' knowledge and skill retention following cardiopulmonary resuscitation training and concluded that resuscitation training should be based on in-hospital scenarios and current evidence-based guidelines, to include training in the recognition of symptoms of sick patients. Nurses should also receive automated external defibrillation training (ibid.). In another review exploring the use of simulation to teach resuscitation (Long, 2005) the results demonstrated that using simulation to learn resuscitation can improve healthcare professionals' and students' performance in clinical practice.

3.1.2 *Summary of section 3.1*

Research using simulation for learning skills and resuscitation in nursing practice demonstrates that simulation is a promising method used under appropriate conditions.

3.2 Simulation in nursing education

In Norway, limited research has been done on using simulation in nursing education. One study conducted by Kyrkjebø et al. (2006) tested a simulated training program in inter-professional student teams (medical, nursing and intensive nursing) which were exposed to two simulation scenarios twice. The findings suggested that the students were satisfied with the program and had learnt a lot about their own team performance, personal reactions and lack of certain competencies. The simulation exercise enhances the students' learning process through reflections on their own and other team members' roles.

A study conducted by Wellard and Heggen (2010) compared nursing skill laboratories in Australia and Norway. What is interesting in relation to this study is the pedagogical approach of the teachers. Wellard and Heggen (2010) explored the use of laboratories in both countries in preparing nursing students for entry to practice and identified the pedagogical challenges. In both countries, the participants reposted a common approach to instruction: a process of teacher demonstration, followed by student repetition and practice. Results revealed that faculty members had a high degree of motivation and trust in the contribution that laboratories have in developing students' skills, but these same faculty could not justify evidence for their pedagogical approach.

Numerous articles have been published outside Norway describing the use of simulation and how simulation programs have been developed within nursing education, primarily with undergraduate students. These articles indicate that simulation is a valuable method in nursing education (Peteani, 2004; Rauen, 2004) but requires considerable time in planning and implementation (Childs & Sepples, 2006; Rhodes & Curran, 2005) as well as basic concepts and guidance for implementation (McCausland et al., 2004).

3.2.1 *Evaluative studies*

Few studies have examined if the participants perceive skills learned in the simulation setting to be transferable to clinical practice. One of the studies examining this was conducted by Feingold et al. (2004) to evaluate nursing student and faculty perceptions of patient simulation. The researchers surveyed 65 students who had participated in simulations over two semesters, and 4 faculty members. The findings reveal that while the majority of students and faculty felt the simulations were realistic and valuable, only half of the students agreed that skills learned in the simulation were transformable to a real patient-care setting.

3.2.2 *Experimental and quasi-experimental studies*

Several studies have determined the effect of simulation-based learning on knowledge and skills in nursing education. A study conducted by Alinier et al. (2006) determined the effect of simulation-based training on nursing students' clinical skills and competence by using a pre-test/post-test design. The results demonstrated that the experimental and control groups improved their performance on Objective Structured Clinical Examination (OSCE).

Another study compared two instructional methods for teaching acute myocardial infarction to see how effectively they promoted nursing students' knowledge and confidence (Brannan et al., 2008). The instructional methods consisted of an interactive approach using simulation and a traditional classroom lecture. Results suggested that use of simulation made a positive difference in the nursing students' ability to answer questions when their knowledge was tested. Students' confidence was not found to be significantly enhanced by use of simulation.

One study (Bearnson & Wiker, 2005) highlights simulation-based education as beneficial in preparing nursing students for clinical practice. According to the results, the nursing students' responses clearly revealed that simulation should be used in addition to clinical practice. Bearnson and Wiker (2005) explored the benefits and limitations of using simulation as a substitute for a clinical day in a junior-level nursing course. Each student had a 2-hour session involving three pre-programmed scenarios. Following the scenarios, the students completed a survey instrument. The results demonstrated that the simulation sessions increased knowledge of medication side effects and the ability to administer medication safely, and improved knowledge of differences in patients' responses. The students' responses indicated that the simulation should be held in addition to, not instead of a clinical day. Limitations of the simulation were that only a few students were active at a time and that intravenous administration was the only choice available on the patient simulator.

A few studies have described the long-term effect of using simulation in nursing education. Hoffman et al. (2007) used the Basic Knowledge Assessment Tool-6 to measure improvement of knowledge in senior nursing students after seven weeks of simulation-based education and seven weeks of a traditional clinical experience. After simulation-based education, scores were found to be significantly better in six of eight subscales: the two subscales that did not show significant improvement assessed issues which had not been factored into the simulation.

3.2.3 *Simulation for learning resuscitation in nursing education*

A few studies in the nursing education literature examine simulation for learning resuscitation. As in the field of nursing practice and nursing education in general, these studies focus on the outcome or evaluation of using simulation, or describe the process of development and implementation of simulation into the curriculum.

One study examined pre- and post-test knowledge of cardiac event management in nursing education (Scherer et al., 2007). They found no difference between the experimental group (simulation) and control group (case study seminar).

A study evaluating the effectiveness of implementing a cardiac arrest using simulation in undergraduate- and graduate nursing education demonstrated that post-simulation knowledge scores were significantly higher than pre-simulation scores (Bruce et al., 2009). Students at both levels reposted high satisfaction with the experience and with the opportunity to participate in simulated cardiac arrest teamwork.

Another recent study examined the effect of monthly practice on nursing students' CPR psychomotor skill performance at 3, 6, 9, and 12 months compared to a control group with no practice, and of repeating the initial BLS course at 12 months (Oermann et al., 2011). Results revealed that the nursing students in the experimental group needed repetitive monthly simulations to perform CPR accurately. Students in the control group showed a significant loss of compression skills after 9 and 12 months and ventilation skills after 3 months.

Kardong Edgren et al. (2008) conducted a study aimed at designing three scenarios (one cardiac arrest) comparing nursing student perceptions of simulation experience over time and characterizing faculty perceptions of the simulation implementation process. The results indicate that the nursing students perceived the design and implementation to be very agreeable (measuring self-confidence and satisfaction), while faculty reactions to simulation were mixed. The use of repetitive practice of fundamental skills to enhance learning outcomes was emphasized.

Linnard-Palmer (1996) studied the effect of CPR skill algorithm on nursing students' response rate, skill accuracy and reposted attention management during simulated cardiopulmonary arrests. The results demonstrate that none of the five nursing students were able to accurately perform basic CPR skills at baseline. The number of simulations needed to perform the CPR-algorithm with 100% accuracy in less than four minutes ranged from six to thirteen simulations. The application of the CPR-algorithm and supportive information on emergency equipment was found to be an effective tool to increase skills accuracy and to decrease response time.

One study examined simulation in relation to how satisfied fifty-five nursing students were with their' nursing education when exposed to simulation-based arrhythmias and CPR training (Childs & Sepples, 2006). Overall, these nursing students evaluated the simulation experience as positive and enjoyable and felt they learned the most from the CPR training.

Finally, two studies described the process of developing and implementing cardiac arrest scenarios (Hravnak, et al., 2007; Spunt et al., 2004). Spunt et al. (2004) describe the development and implementation of a simulation cardiac arrest module in a nursing education program. Evaluation of the objectives for the module centred on the ability of the student to perform the skills required for participation in life-saving situations and skills such as paddle placement and effectiveness of chest compressions. Hravnak et al. (2007) describe how simulation can be used as a tool for (nursing) education in cardiac care, and discussed the advantages and disadvantages of simulation in learning. The main advantages they point out is that complex and difficult tasks are taught and practiced in an environment which provides experience without endangering patients. Hravnak et al. (2007) also state that true patient-provider interaction is limited and educators must be knowledgeable and able to provide scientific evidence as the basis for the practice enacted.

3.2.4 *Summary of section 3.2*

Research using simulation for learning in nursing education reveals that the role of the faculty is of vital importance in simulation-based learning, although the latter lack evidence to support their pedagogical approach in nursing laboratories. Research indicates that simulation enhance student learning, but it is questionable if knowledge and skills learned in the simulation are transformable to a real patient care setting.

Research indicates that nursing students improve their resuscitation knowledge and skills by using simulation. Moreover, it has been shown that nursing students are satisfied with the method and that it improves their confidence. Some questions can be raised in response to these studies, however. If nursing students improve their confidence and are satisfied with simulation practice, does this mean that it enhances learning? Several studies point to the disadvantages of simulation, such as limited transferability to a real patient care setting. However, questions remain unanswered concerning what conditions in simulation are critical for learning, *what* it is in simulation that improves performance and *how* this practice functions as an arena for training team-based resuscitation in nursing education.

In contrast to the studies presented above, the following section will present studies of simulation rooted in the social-cultural perspective. These, like the present study, investigate simulation as a social practice and reveal what is going on in the 'black box' of simulation in order for us to better understand the complexity inherent in all phases of the simulation activity.

3.3 Studies of simulation as a social practice

In this section, research in simulation-based learning is presented to which I will later make connections. In contrast to the research presented above, these studies of simulation in medical and post-graduate anaesthesiology education provide a more detailed and deep understanding of what is critical for learning to occur. Most of the studies presented earlier in this chapter test whether an educational practice (simulation) makes a difference to individuals or not. These experimentally designed studies determine if an intervention such as simulation influences an outcome or dependent variables, e.g. knowledge and skills, by determining whether those who experienced the intervention performed better on some outcomes than those who did not experience it (Creswell, 2012). By studying the causal relationship between a number of independent and dependent variables as in experimentally designed studies, we will forego understanding of what may be hidden behind the general causal relationships (Rystedt, 2002). In this section, the presented studies focus on simulation activities in situ by conducting detailed analysis of students' and teachers' interaction. This research contributes to increased knowledge about simulation as a social practice involving an analytical focus on what is going on in simulation practice, and how students contextualize the simulation as clinical practice. These studies demonstrate that, among other things, the facilitators' instructions are central to students' orientation in the simulation and thereby become the focus of the participants.

Rystedt and Lindwall (2004) demonstrate how students in post-graduate anaesthesiology education often switch between three different learning foci in simulation connected to three different learning objectives: theoretical aspects, practical aspects and the simulation itself. What is learned is not given by how the scenario is structured, but is something that is constructed within the participants' interaction in the specific environment. Above all, the study shows that the provision of guidance is a sensitive process, where subtle aspects of instruction and guidance are decisive for what is constituted as the learning object.

In a study of screen-based simulation in post-graduate anaesthesia education, Rystedt (2002) demonstrates how simulation can be useful for the professions by offering opportunities for students to deal with problems of central importance in their future work practice. In order for this to occur, the potential of the learning environment to enable students to generalise beyond the immediate educational situation is a decisive aspect. The concrete conditions necessary for realising these boundary crossing possibilities are, for example the specific resources (prior experience from education and work) needed for understanding and acting in the simulation environment. The study emphasises the integration of simulation in curricula, the significance of the theoretical content, the intertwinement with work practice, and the role of supervision. These conditions are of vital importance for learning to occur.

In medical education, Johnson (2004) demonstrated how instructors construct a context around the simulator which frames the tasks for the medical students as a part of the professional role. The instructors' guidance becomes central to how the students as medical professionals present themselves to the patient; what is said, where they stand and what is done. Johnson (2004) shows how medical participants and medical techniques are reconstituted[3] through the use

[3] Johnson (2004) defines the concept 'reconstitute' as: "that participation which is recreating medical practices out of the reified practices and understandings materialized in the simulators" (p. 71).

of a minimally invasive surgery simulator. Reconstitution thus allows participants to specifically learn medical practice that goes beyond the tasks and objectives of the simulator. The simulation not only implies a reconstruction of a technical environment made for training specific procedures, but goes beyond this because it is possible to reconstitute a medical practice which functions as a learning environment for the students' socialisations into the professional role.

3.4 Summary of simulation research presented in chapter 3

Research demonstrates that simulation-based learning in nursing practice is a promising educational method used under appropriate conditions. Studies of using simulation in nursing education reveal that the role of the faculty is crucial to its success. Research using simulation in nursing education for performing resuscitation has been most concerned with the goal of justifying its use and proving that it works or pointing to the disadvantages such as limited patient-provider interaction and limited transferability to a real patient care setting (Childs & Sepples, 2006; Kardong-Edgren, et al., 2008; Linnard-Palmer, 1996; Scherer, et al., 2007). According to Issenberg et al. (2010) these studies do little to advance the field of human learning and training. Eva (2010) suggests that we "move away from research that is intended to prove effectiveness of our educational endeavours and towards research that aims to understand the complexity inherent in those activities"(p. 4).

Consequently, more research is needed to understand the critical conditions for learning in simulation and *what* elements of the simulation are creative for the learning process. Further exploration is also needed to understand the complex process of constructing knowledge in simulation practice and how this practice functions as an arena for learning team-based resuscitation.

4 Theoretical perspective

The overall aim of this thesis is to develop knowledge about the critical conditions for learning team-based resuscitation in simulation-based learning environments. This aim involves an interest in how simulation can provide an arena for nursing students' participation, how simulators can function as mediating tools for learning, and how social order is established and accounted for in simulations. The theoretical perspective presented in this chapter has been developed for dealing with this objective and for addressing the more specific research questions posed in the first chapter. Choosing a perspective implies taking a distinct view of the phenomena under study herein a socio-cultural perspective, chosen as the point of view for investigating simulation practices (Säljö, 2001). This perspective was chosen because it contains a basic assumption that knowledge is constructed in participation and interaction between participants and artefacts in social practices, i.e. simulation practice.

This chapter starts with a positioning of the present study in the socio-cultural perspective, which emphasizes that learning is *mediated* through *artefacts* and tools and in interaction with others (Säljö, 2001; Wertsch et al., 1995). We then move on to look at the theoretical point of departure in some basic principles of ethnomethodology (Garfinkel, 1984) in order to bring attention to how *social order* is constituted in the participants' interaction.

4.1 Socio-cultural perspective

The socio-cultural view of learning has its roots in Vygotsky's work, in which learning is seen as a possible result of all human activities. Knowledge cannot be separated from the actual situation in which it is developed. According to Vygotsky (1986) language and thought is linked, in that "thought is not merely expressed in words; it comes into existence through them" (p. 218).

In a socio-cultural perspective on learning it is emphasized that knowledge is constituted in interaction and not through individual processes (Säljö, 2001). Learning is thus a result of individuals' participation in activities with others and artefacts in a cultural context. Learning from this perspective is seen as a side effect of the activity in which we participate. The constitution of an activity is thus fundamental to what is possible to learn, and communication with others is a central element in learning (Säljö, 2001, 2006; Wertsch, 1998). Säljö (2006) proposes that an important starting point in understanding learning is to consider knowledge and learning as situated, i.e. as something that emanates from the situated interaction in social practices. It is not possible to understand how people develop and learn, if the character of the situated learning is not taken into account. Consequently, activity is the unit of analysis, not the individuals, meaning that analyzing the use of language and artefacts are necessary to understand learning (Säljö, 2001). From this follows that human beings cannot fail to learn, the question is rather what they learn in different situations (Säljö & Linderoth, 2002).

A basic idea in the socio-cultural perspective is that learning and cognitive development are dependent on the individual's participation in practices within the relationship where the development takes place (Wenger, 1998). Wenger explores the term 'practice', using it to encompass a wide variety of practices (social practice, cultural practice, embedded practice, etc.). He only uses the word 'practice' because "in this sense, practice is always social practice" (Wenger, 1998, p. 47). His definition of the concept 'practice' includes:

> …..both the explicit and the tacit. It includes what is said and what is left unsaid; what is represented and what is assumed. It includes the language, tools, documents, images, symbols, well-defined roles, specified criteria, codified procedures, regulations, and contracts that various practices make explicit for a variety of purposes. But it also includes all the implicit relations, tacit conventions, subtle cues, untold rules of thumb, recognizable intuitions, specific perceptions, well-tuned sensitivities, embodied understandings, underlying assumptions, and shared world views (Wenger, 1998, p. 47).

Lave and Wenger (1991) describe how apprenticeship in community of practice functions as a pedagogical environment. The learner becomes an apprentice in a social practice and is guided by a master. The learner can observe how the master accomplishes different situations and skills before he/she emulates this. In the 'learning' events studied in this thesis, the interaction between people and the socio-cultural tools such as language, gestures and physical artefacts are central, meaning that the patient simulator and medical devices are critical to understanding the learning process (Säljö, 2006).

From a socio-cultural perspective we act on the basis of our knowledge and experience. In nursing practice, for instance, it is appropriate to ask patients how they are and expect a response from them concerning their state of health. If the nurse asks the same question to her neighbour, the expected answer would be different such as a general comment about how the day has been. Similar conventions help the nursing students in simulation practice to make sense of how the situation should be understood, what to say and do and what not to say and do. In most environments we can follow well-established rules and routines that pre-interpret the situation for us. We know what actions are relevant and can change them when the settings for practice change, thus illustrating how communication has to be understood on the basis of the situation in which it occurs (Säljö, 2001). Nevertheless, it could be very complicated for nursing students to use their previous experience and knowledge in simulation practice since its conditions are different (Säljö, 2001).

4.1.1 *Mediation*

In the socio-cultural perspective, actions are *mediated* by the resources and tools we use (Wertsch, et al., 1995). The concept of mediation originated from the German word ‘Vermittlung’ (English translation: ‘mediation’), suggesting that humans are never in direct contact with the world. On the contrary, we deal with the outside world by using different tools and resources which constitute integrated parts of our social practices (Säljö, 2001). The tools are critical for how we use our intellectual resources, our body, and how we interact with others. Säljö (2008) proposes that the interaction between people can be understood as a basic mechanism for *mediation*. All conversations involve mediation, and people are in some ways constantly making use of *mediating* resources in interaction. A gaze, a questioning tone or a description of an event, mediates the world for the conversation partner in a specific way which may provide opportunities for learning. New artefacts such as patient simulators enable new forms of interactivity between man and technology and the opportunity to design situations, which might support learning. The development of these new artefacts, e.g. patient simulators, does not mean that the learning problem is solved, but that the conditions for learning are changed (Säljö, 2006).

Wertsch (1995) argues that language is the most important cultural tool humans have. Language is therefore in a unique focal position when learning processes are going to be studied. Words and language statements *mediate* the outside world for us and make it possible to conceive as meaningful. By communicating with others we take part in constituting the world as orderly and enable ourselves to understand and interact with each other in various activities (Säljö, 2001).

4.1.2 *Artefacts*

Säljö (2006) defines physical *artefacts* or tools as objects or products that are created by humans for specific use, e.g. computers, telephones and books. Culturally accumulated knowledge and experience are stored in artefacts (Säljö, 2008) by virtue of the fact that we apply our experience to create them, and thereby allow knowledge to survive in society. An example of this is the innovations and development of technology used in computers and simulators. Artefacts are created to function as tools for humans in, for example, problem solving. Säljö (2001) points to humans as the 'communicating creature' who uses socio-cultural tools or artefacts in the learning process. We make our experiences by means of artefacts as mediating tools. To understand the learning activities studied in this thesis, I have applied the socio-cultural understanding of tools, i.e. the use of language in combination with physical artefacts such as a patient simulator and medical devices. The interaction between the participants and the artefacts in simulation practice are central to what and how the nursing students experience and potentially will learn (Säljö, 2006).

Wertsch et al. (1995) emphasize that mediation is an active process involving the possibility of cultural tools or *artefacts* to shape action and the unique use of these *artefacts*. The tools or artefacts involved in mediation play an essential role in shaping action, but this does not mean that they determine or cause action (Wertsch, et al., 1995). In and of themselves, the *artefacts* cannot do anything. This view that tools and *artefacts* are means for actions is vital in understanding and analyzing how patient simulators and medical devices are parts of shaping action and forms of interactivity in simulation practice.

4.1.3 *Participation*

Säljö (2006) claims that learning primarily occurs through *participation* in activities and as a consequence of *participation*, and not only through teaching. “Participation refers to a process of taking part and also the relations with others that reflect this process” (Wenger, 1998, p. 55). Hindmarsh (2010) shows what possibilities for *participation* there are in clinical dental training. Clinical dental training it treated as an instance of apprentice learning in order to consider aspects of the real-time organization of the training and to delineate some of the embodied practices in and through which dental practice reproduces itself. The first possibility for *participation* involves what can be observed in dental practice. The student explores how to observe when inspecting the patient’s oral cavity and this observation, in turn, is assessed by the facilitator. The second possibility of *participation* involves a ‘modelling’ approach to learning, in which the student watches whilst the facilitator examines the patient’s teeth and provides an account of what they can see or feel during the examination. The third possibility of *participation* is when the facilitator performs an examination of the patient and explains to the viewing student what can be seen rather than merely ‘translated’ it for the patient. The comments are designed for and directed to the student and understood as such. The fact that the facilitator renders them visible means that if the student has not previously noticed them, he/she can now take them into account.

This understanding of participation in dental practice highlights the ways in which participation is an important part of learning processes in general (Hindmarsh, 2010) and central for understanding learning in simulation practice. As Gherardi and Nicolini (2002) suggest: “Novices learn first by watching, looking, seeing and listening to others while carrying out meaningful activities” (p. 216).

4.1.4 *Social order*

This study takes its theoretical point of departure in some of the basic principles of ethnomethodology[4] (Garfinkel, 1967) and in research on how social order is constituted in technology-intense settings such as operating theatres (Hindmarsh & Pilnick, 2002) and dental training (Hindmarsh, 2010). The adoption of such a perspective on interaction in simulation practice involves working from the assumption that the participants' own ways of understanding and furthering the activities they are involved in should guide the research. The fundamental assumption is that, even though the theoretically-informed researcher will understand a certain activity in particular ways, the practice is nevertheless already understood in specific ways by those participating in it. These ways of understanding the activity will have a direct impact on how the activity is played out. Ethnomethodologists are concerned with how *social order* in society and in everyday life is constituted and how it is maintained. For example, standing in a line, like any other social activity, is reliant on an array of visual, interactional, and embodied competencies. Commonly, these order-productive competencies are taken for granted; they are "seen but unnoticed" (Garfinkel, 1967, p. 41). In interaction, humans construe the reality as orderly, but in doing this, simultaneously reconstruct it. Ethnomethodology can be described as a way of investigating the genealogical relationship between social practices and accounts of those practices (Lynch, 1993). The goal of ethnomethodology is to identify the members' *methods* for coordinating their actions by scrutinizing how they make their actions and intentions intelligible to each other (Garfinkel, 1967).

Garfinkel (1967) was concerned with understanding how *social order* is maintained by studying in detail the methods that people produce to make their actions understandable and accountable. He looked at social order as a process and not a strict order. A central premise is that we are able to refer to or account for our actions (talk and body language) in social interaction with

[4] Ethnomethodology originates from Greek and refers to the practices or methods (methodologies/micro techniques) that people (ethno) use to maintain everyday life, and human purpose of interacting (Silverman, 2006).

our fellow human beings. For social interaction to be maintained, we have to act meaningfully, i.e. provide gestures and signals that can be perceived by others and accounted for as referring to some common endeavour. We can understand this in the way that people act in accordance with a mutual, sanctioned social order. Both order and stability and disorder and breaches are created by people. These breaches, which could be verbal interruptions such as someone laughing, give cues as to when order has been transgressed, and as to what kind of actions are needed to re-establish social order. In the present study, I will use this understanding in analysing what resources and actions the participants use in maintaining and re-establishing social order in simulation practices.

4.2 Summary of the theoretical perspective

In this chapter, a socio-cultural approach to learning has been presented having a point of departure in socio-cultural theory where artefacts and tools (the patient simulator and medical devices) mediate learning through interaction in a social practice (simulation practice). In this thesis learning is viewed as participation in social activities with others. An ethno-methodological perspective draws attention to the participants' own methods for coordinating their actions and for how participants continuously create and re-establish social order in simulation practice.

5 Methodology

5.1 Research design

The overarching aim of the study is to develop knowledge about the critical conditions for learning team-based resuscitation in simulation-based learning environments. The entire thesis can be considered an explorative and descriptive study (Polit & Beck, 2010). In order to answer the research problem in this study, we had to perform studies with different methodological approaches (qualitative and quantitative methods) which remained separate during the analysis phase (Table 1). This study contains elements of component design (Polit & Beck, 2004, p. 279). Qualitative (**paper I, II,** and **III**) and quantitative (**paper III and IV**) methods are used, and finally the results are discussed as a whole. The thesis draws on data from only one source: video-recorded simulations from three different phases of simulation; the briefing, simulation scenario and debriefing. The data were collected from one sample. Using both qualitative and quantitative data in this thesis does not necessarily mean that 'the whole is greater than the sum of the parts' (Johnson & Christensen, 2011). Nevertheless, qualitative and quantitative methods may help improve the quality of research because the different research methods can provide answers to different research questions and can give a richer account than either approach alone (Johnson & Christensen, 2011).

Paper I and **II** have an inductive design and are based on *interaction analysis* when the purpose was to study how the nursing students and faculty understand and act in simulation practice (in the briefing and simulation scenario) (Heath et al., 2010).

In **Paper III** an inductive content analysis was performed to code and categorize the content regarding leadership discussed during the debriefings (Krippendorff, 2004). A deductive theory-driven content analysis was used to grade and quantify the facilitators' questions and nursing students' responses in the debriefing into levels of reflection.

Paper IV has a comparative design based on observations of the participants' performance, when the purpose was to investigate the extent to which nursing student teams[5] follow the D-CPR-algorithm in a simulated cardiac arrest, and to examine if observing one simulated cardiac arrest scenario and participation in one debriefing could improve team performance of D-CPR in a subsequent simulation (Polit & Beck, 2004).

Table 1. Overview of all four sub-studies in the thesis

Sub-studies	Design	Focus	Partici-pants	Data collection method	Analysis
P I	Explorative and descriptive (inductive)	Instructional problems in briefings	81 nursing students 5 faculty	14 video-recordings	Interaction analysis
P II	Explorative and descriptive (inductive)	Nursing students' coordination in simulated cardiac arrest	81 nursing students 5 faculty	28 video-recordings	Content analysis Interaction analysis
P III	Explorative and descriptive (inductive-deductive)	Levels of reflection in questions and responses in the debriefing	81 nursing students 5 faculty	28 video-recordings	Content analysis
P IV	Descriptive and comparative	Performance of D-CPR before or after observing others' performance and participation in a debriefing	81 nursing students 5 faculty	28 video-recordings	Descriptive statistics, t-test, Wilcoxon signed rank test

[5] 'Teams' is here defined as a 'group who share common health goals and common objectives, determined by community needs, to the achievement of which each member contributes, in accordance with his or her competence and skill and in coordination with the functions of others' (WHO, 1984, p. 13).

5.2 Participants

The study participants are nursing students and faculty requested from one nursing education location in Norway. The only inclusion criterion was that nursing students had been admitted as such in the third year of their education. A total of 81 nursing students (72 female and 9 male, of average age 27 in the age range 22-53) studying in their last semester of a three-year nursing education program participated in the study. The nursing students were divided into 14 groups, each of which comprised between 4 and 7 team members. Four groups were mixed gender while the remainder were females only. The median age in the 14 groups varied from 23 to 33 years (Table 2).

The nursing students were informed both verbally and in writing two weeks in advance of the onset of data collection by one of the university faculty members who was not participating in the study. The written information, including a consent form, was handed out to nursing students at the same time (Appendix 1). In addition, the written information was posted on the university's web-based learning platform, 'It's learning'. All admitted nursing students at the university had access to the platform. Information to the students was repeated by the researcher at the simulation centre prior to the simulation module, and the consent form was signed by the nursing students as well as the faculty (Appendix 1). All those who were asked to participate voluntarily agreed to do so. None of the nursing students and faculty declined to participate in retrospect.

Table 2. Demographic data

Group	Sex	Mean age	Range
1	6 females	29	22-53
2	6 females	23	22-24
3	6 females	25	22-31
4	6 females	28	22-33
5	4 females, 2 males	28	22-34
6	4 females	25	22-30
7	6 females	30	24-49
8	6 females	33	23-42
9	2 females, 3 males	25	22-32
10	6 females	27	22-35
11	4 females, 1 male	27	22-41
12	5 females	25	22-27
13	4 females, 3 males	31	23-47
14	7 females	27	22-37
	72 females (89%) 9 males (11%)	Mean 27	22-53

5.3 The setting

The study took place in the Stavanger Acute medicine Foundation for Education and Research (SAFER) simulation centre in a location resembling a patient room in an out-of-hospital rehabilitation unit. The room contained a wall source of oxygen supply, a desk with medical devices e.g. an oral airway, a bag-mask and medication and drawers with injection devices (Figure 3).

Figure 3. The simulation room

The control room is contiguous to the simulation room. A one-way mirror separates the two rooms and allows the faculty to control the simulated scenario and view the nursing students' actions within the room; a microphone system is used to communicate between the rooms. The control room houses the computer software and all of the sound and video equipment (Figure 4). There are two cameras mounted at 90-degree angles facing the bed to video-record the simulation scenarios from various views. The videotaped scenarios allow for viewing and feedback in the debriefing. The simulator in use was a patient simulator (SimMan^{TM}, Laerdal Medical) positioned in a standard hospital bed (cf. section 2.4 *Simulators in nursing education*).

Figure 4. Operator room

5.3.1 *The simulation phases in relation to this thesis*

The seven-step process described by Bailey et al. (2010) guided the development and implementation of the simulation scenario used in this study (cf. 2.2.1 *The phases in simulation*). The cardiac arrest scenario based on the cardiopulmonary resuscitation guidelines from 2005 (Handley et al., 2005) was developed for simulation purpose for the last semester in bachelor nursing education (see Appendix 2). The learning objectives were 1) optimizing leadership in resuscitation teams and 2) putting the BLS algorithm into practice. All objectives were part of the nursing students' last clinical practice. The simulated patient was a 71 year-old woman who had suffered an upper femur fracture and had been moved to an out-of-hospital rehabilitation unit without a staff physician present. The patient had a history of angina pectoris and went into cardiac arrest during the scenario (Appendix 2).

In this study, the nursing student groups were divided in two, simulating the scenario once each. For each scenario, one student was selected to be the team leader and the others to be assisting nurses. The remaining nursing students and the facilitator were present in the room and observed the scenario. In the second scenario, the students changed roles. Since nursing students are learning to be nurses, it makes sense that they be allowed to be nurses in the scenario developed for this study.

5.4 The researcher's role

Conducting research in your own culture raises some questions and challenges. The field I have studied, simulation practice in nursing education, is my own place of work. I have worked with the nursing programme under study since 1999 and with simulation-based education since 2005. I know the culture of the nursing education and my colleagues. My pre-understanding will influence the entire research process but, at the same time may be an important motivation to start the study (Malterud, 2011). My experience with simulation in nursing education may be useful to the research, but also contribute to blinders and limited horizons (ibid.). To prevent "going native" I spent nearly half a year writing the research proposal, which, in my view, can be considered as a process of expanding awareness. During the entire research period I thought about what I would expect to find in the data and the theoretical perspective for interpretation of the findings. The supervisors have constantly challenged my view and interpretation of the research. Moreover, I have been encouraged by my research fellows to not only be enthusiastic about but also critical of simulation practice.

The researcher will always influence the research process; the question is how this is done (Malterud, 2011). Since all the participants were informed that the simulation was going to be video-recorded, one cannot ignore that this awareness influenced the facilitators and nursing students' actions inasmuch as they acted in the way they thought was expected of them. The presence of me as a researcher rather than as facilitator could have influenced the participants in a similar way, although I was not present in the room where the simulation took place.

5.5 Research ethics and dilemmas

The study was approved by the Norwegian Social Science Data Services (NSD) (Appendix 3) and the University of Stavanger (Appendix 4). Consent forms were signed by the nursing students as well as participating faculty members, and confidentiality was guaranteed (Appendix 1). In all figures used in papers, the face of the participants has been retouched (**paper I** and **II**). In retrospect, the guarantee of confidentiality for single faculty members might be questioned, since the rest of the faculty was quite aware of which teachers participated in the study. This has been and must be taken into account in my presentation of the research. Whether students or colleagues, all those who were asked agreed to participate in the study. Since the researcher was a faculty member of the university, it cannot be excluded that the nursing students and faculty may have felt pressure to participate. Participation in simulation and in a research project may cause stress and put strain on the nursing students.

For the type of research presented here, the ethics committee of the western part of Norway declined to consider the application because the study did not involve patients or relatives (Appendix 5).

In retrospect, there might be a risk that the participants experience the results of the study as an assessment or evaluation of what is good and bad performance in simulation practice. To capture such reactions I have had on-going discussions about the study with my colleagues and offered them **paper I** and **II** to read. The feedback has been positive in the sense that they see the research as important in improving simulation pedagogy. Prior to the simulation events, it was communicated to the nursing students that attention was being given to the learning process in the teams rather than to assessment of individuals.

Presenting and exposing the use of language can be a personal matter especially when it takes place as part of nursing students' education and teachers' professional practice. Nursing students and teachers (and colleagues) can be vulnerable to descriptions of their communication practices. Oral communication is different to written language in terms of syntax and use of words, and the presentation of transcribed talk may thus appear discontinuous and unstructured, leading the conversation participants feeling humiliated and embarrassed. Being aware of this requires the researcher to think carefully about how to deal with it in presenting the analysis. In this case, some of the students and teachers may have felt disproportionately exposed in relation to the importance of the results of the study. However, I tried to address the issue of respect by making sure all participants were informed about the aim of the study and that the research would result in a thesis.

This research was supported by the Laerdal Foundation for Acute Medicine, without any interference on their part throughout the study period. I consider this study to be research on simulation as a pedagogical method, not a study on patient simulators.

5.6 Educational content related to the simulated cardiac arrest scenario

In the academic year 2007-2008 when the data collection in this study took place, a defibrillation and cardiopulmonary resuscitation (D-CPR) course was offered as a voluntary course to nursing students in year 3 (Figure 5). The subject matter in this study was based on the European Resuscitation Guidelines for CPR and use of automated external defibrillators (AED) from 2005 (Handley, et al., 2005). From the academic year 2008-2009 the course was implemented as mandatory in year 2.

Figure 5. The D-CPR course

year 1	Mandatory individual CPR training in classes based on a computer-based learning program (Learning CPR with Mini-Anne)
year 3	1.A two-hour lecture in D-CPR 2.A one-hour individual based training in D-CPR 3.A two-hour team oriented simulation-based training in D-CPR

5.7 Data collection

The data was collected in February and March 2008. All three simulation phases in nursing student teams were video-recorded, resulting in about 28 hours of data material (Figure 6). The 81 students were divided into 14 teams. The 14 teams were only briefed once. Within each team the students were split in two groups, where the first group simulated in the scenario and participated in the debriefing while the rest attended before swapping roles.

Figure 6. Video-recorded data

Briefing	Simulation scenario	Debriefing
14 briefings were video-recorded	28 simulation scenarios were video-recorded	28 debriefings were video-recorded

Video recordings were chosen as they allow for the capturing and recording of interactions in the simulation setting to occur *naturally* without disturbances from direct observations. Video recordings also allow for repeated viewing and detailed analysis (Heath, et al., 2010). Heath et al. (2010, p.8) claim that "audio-visual recordings are increasingly used to support research that examines the situated activities and interactional organisation through which knowledge, skills and practice are shared and disseminated". Video helps reveal complex interactional behaviour in natural social settings (Heath, et al., 2010). Using other kinds of methods, for example, note-taking or on-the-spot coding means that speech details and aspects of body language will be lost. Video recording has the advantage of permitting permanent records of the social world to be examined and re-examined in the light of different research questions (Goodwin & Heritage, 1990). It also allows focus on both verbal and non-verbal elements of interaction in the simulation setting and analysis of the ways in which these elements of conduct are interwoven in interaction (Goodwin, 2001). In addition, video data can be used for different kinds of methodological approaches and are available for the research community in a way that field notes are not (Silverman, 2006). In this study, several methods of analysing the video data were performed: *content analysis*, *interaction* *analysis* and *statistical analysis,* and these will be elaborated upon further in section 5.8. *Data analyses*.

5.7.1 *Transcription of the video recordings*

The original video recordings were in Norwegian and the presented sequences have been translated into English by the author. Nursing students are marked as S1, S2 and S3, and facilitators as F in **paper I** and **II**. The excerpts presented in **paper I** were based on the guidelines for transcription suggested by Heath et al. (2010). Pauses are represented by numbers of seconds within brackets, with (.) indicating micro pauses, and concurrent talk horizontally aligned, with square brackets marking the onset of overlap. Extended vowel sounds are marked with colons as in e::h. Enclosing a sequence in asterisks * indicates talk in a laughing tone. <u>Underlining</u> indicates stressed words, whereas the degree symbol ° means that the speech enclosed was noticeably quieter. Extra-linguistic action is included as comments within double parentheses, with *italicized* letters serving to better distinguish these from talk. Furthermore, the transcript is complemented with pictures that represent the gestures of the facilitator and nursing students. The notation of Heath et al. (2010) was used in **paper I** to demonstrate the significance of minute details of communicative actions in moment-to-moment interactions.

5.8 Data analyses

Several methods of data analysis were found appropriate to answer the research questions in the thesis (Table 1). The analysis included interaction analysis (Heath, et al., 2010), content analysis (Krippendorff, 2004), descriptive statistics, the statistical analysis t-test and Wilcoxon signed rank test (Polit & Beck, 2010) and inter-rater reliability with kappa and linear weighting using VassarStats[6] (Fleiss et al., 2004).

[6] http://faculty.vassar.edu/lowry/VassarStats.html

5.8.1 *Interaction analysis*

Interaction Analysis was performed in **paper I** and **II**. The analyses follow the three steps suggested by Heath et al. (2010) and recommendations by Jordan and Henderson (1995). In undertaking a preliminary review, all the video recordings from the briefings and simulation scenarios were viewed. In step two, the video recordings were systematically reviewed with focus on events in the interaction between the facilitator and the nursing students, and within the nursing student teams. In the third step, an analytic review of the data corpus was undertaken and eleven briefings and twenty eight simulation scenarios from the material were chosen for further analysis. The briefing and simulation scenarios examples were transcribed in more detail by additionally marking the facilitators' and nursing students' glances in relation to the conversation and gestures. This proved to be necessary for understanding how the participants' actions were furthered by the actions of the others.

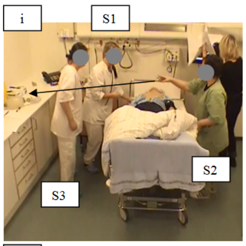
As the analysis progressed, the authors identified recurrent patterns in the facilitators' instructions and the nursing students' response to these instructions (**paper I**) and in the nursing students' coordination of the Basic life Support algorithm (**paper II**). Similarly, instances of interaction patterns were then compared to find deviant cases and to check whether the general patterns were representative for all briefings and simulation scenarios. When performing the analysis in **paper I** and **II**, the video-recordings were subjected to collective analysis at the Linnaeus Centre for Research on Learning, Interaction and mediated Communication (LinCS) in Gothenburg, Sweden[7].

Presented below is an example of an in-depth analysis from the simulation scenario which was not included in **paper II**. The analysis is performed this way to emphasize non-verbal aspects of communication such as pointing and gazing, and the interplay between non-verbal and verbal modes . The episode occurs a few minutes after the simulation scenario has started, the students having confirmed unconsciousness and absence of breathing and now displaying how they achieve division of labour. Simultaneous gazes, pointing

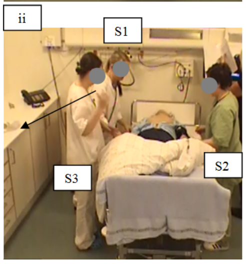
[7] The PhD candidate had a study period at this centre in spring 2009.

and verbal confirmation are employed as shared resources for arriving at consensus on the assignment of roles and the achievement of an optimal division of labour that will ensure open airways and access to appropriate medical equipment (Figure 7).

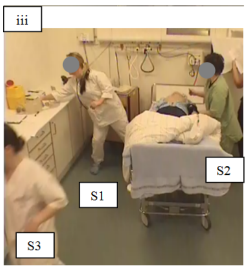
Figure 7. Gazing, pointing and verbal confirmation when assigning roles



The arrow is pointing to the tube on the desk.
After S1 has confirmed S3's statement about the absence of breathing, she glances at S2, who immediately responds by smiling and laughing *"haa ha"* then glances back at S1 and points to the tube on the desk.



Simultaneously S3 points to the door with her right arm, glancing at S1 and at the same time asking *"should we, should I go and get?"*
The arrow indicates where S3 is pointing, namely out in the corridor.



S1 responds by glancing at S3 and answering *"yes"* and then three seconds later responds to S2's "question" by turning around to the desk saying *"the tube"*. S3 responds to S1's "yes" by walking out of the door to get the medical equipment in the corridor. S1 picks up the tube *on* the desk, turns around, glances at S2 and gives her the tube to place in the mannequin's mouth. S1 responds to S2's action by saying *"if you deal with the respiration I will make the call"*.

S2's pointing gesture presupposes that her team members know where the tube is (Fig.7 i). Her action took place in silence although she was grinning. There was no verbal communication about what S2 wanted from S1 or who should pick up the tube (oral airway), which is necessary to ensure an open airway when ventilating patients. S2's gazing and pointing served the purpose of asking S1 to pick up the tube on the desk and to hand it to her (cf.Hindmarsh & Pilnick, 2002). S2's grin can be considered a sign of uncertainty about what to do, but it disappeared quickly as the activity progressed. Naming the artefact thus provided the answer to S2's tacit question, since the meaning of S1's answer "the tube" is an indexical cue for the tube to be delivered (iii). S2's gesture displays her responsibility for the ventilating role on the team.

When S3 pointed towards the door she implicitly referred to what she was "going to get" and what was supposed to be found there (ii). A prerequisite for S3's utterance was that the participants knew where the medical equipment was and what it consisted of. The utterance indicated that S3 assumed that S1 knew which medical equipment she was referring to. S3's action establishes her role of fetching the medical equipment required for the concerted action of conducting CPR.

5.8.2 *Content analysis*

The analysis in **paper II** and **III** was started by performing content analysis of the transcribed materials. In **paper II,** content analysis was conducted to identify the form of communicative actions occurring in all groups (Krippendorff, 2004). All communicative actions were marked and coded with respect to whether they involved a) *verbal*, b) *nonverbal* and c) simultaneous use of *verbal and nonverbal* communication modes. In addition, these modes were divided with respect to whether they concerned the accomplishment of *joint assessment* or the assembling of *joint actions*. Secondly, the number of all communication actions that occurred in the data was counted.

In **paper III**, content analysis was conducted to identify and categorize what topics regarding leadership in teamwork were discussed among the facilitator and nursing students in the debriefing (Krippendorff, 2004). Codes were grouped into subcategories and categories. The process of coding and categorizing topics regarding leadership in teamwork is demonstrated in Figure 8.

Figure 8. Section from coding and categorising topics regarding leadership in teamwork

Transcribed text	Codes	Subcategories
6. Facilitator: do you have some thoughts about improvement? 7. Student: I don't feel my messages were clear in the same way that M's was with the assistant nurses 8. I should have done more of – you do this and you do that, talk loudly and… 9. Facilitator: mmm 10. Student: it's a bit artificial 11. Facilitator: I'm with you on talking loud and clear, it's very important in a stressful situation where there is sometimes chaos 12. Student: mmm 13. Facilitator: yes, other things you want to practice more 14. Student: as a leader or 15. Facilitator: as a leader yes, you have a lot of responsibility	Student: Directing Facilitator: Speaking loudly	Giving clear messages

5.8.2.1 Theory-driven content analysis

In **paper III** we used theory-driven content analysis to grade levels of reflections in facilitator's questions and nursing students' responses. The analysis was based on a theoretical model of criteria for grading reflective journal writing in physical therapy education developed by Williams et al. (2000). These criteria are a modified version of Boud et al.'s (1985) model of the reflection process. The model is designed for the context of education, can be used to grade written and oral reflection, and is structured for grading questions as well as responses. In this study, the model of Williams et al. (2000) was applied to classify all facilitators' questions and nursing students' responses regarding leadership in all debriefings. Finally, the relationship between all graded questions and responses were described.

5.8.3 *Statistical analysis*

To compare if there were differences between two nursing student-groups (**paper IV**) in D-CPR performance (where the first group performed D-CPR in a simulated cardiac arrest scenario, while the second group performed D-CPR after observing performance of the first group and participating in the debriefing), a paired samples t-test was used for analyses of variables with normal distribution and a Wilcoxon signed rank test for analysis of variables with abnormal distribution (c.f. **Paper IV**). The mean value with standard deviation (SD) was calculated for parametric tests, while the mean values with interquartile range were calculated for non-parametric tests. All tests were two-sided and statistical significance was considered to be $p < 0.05$. All analyses were performed with SPSS version 18 (Chicago, IL). Inter-rater reliability of the video assessment was calculated using kappa and linear weighting using VassarStats. It has been proposed that a kappa score of 0.81-1.00 indicates very good agreement, 0.41-0.80 moderate to good agreement, 0.21-0.40 fair agreement and below 0.20 poor agreement.

5.9 Strengths and limitations of the method

Lincoln and Guba (1985) propose that the basic issue in relation to trustworthiness in research is how the researcher can persuade his/her audience that the findings of an inquiry are worth paying attention to and worth taking account of. In qualitative research, Lincoln and Guba (1985) suggest four criteria and associated strategies that researchers have to consider. These criteria are: credibility, transferability, dependability and conformability. This understanding of the criteria proposed by Lincoln and Guba (1985) is employed here in the discussion of the strengths and limitations of the methods used in this thesis, as well as in discussing relevant method literature for the analysis of naturally occurring social interaction.

5.9.1 *Credibility*

Credibility concerns whether or not the researcher has studied the phenomenon as intended, and the extent to which our observations reveal the phenomenon that is of interest to us (Lincoln & Guba, 1985). According to Lincoln and Guba (1985), the ways in which a research study may be shown to be credible include self-awareness in the researcher, knowledge of the culture and context, minimization of distortion and building trust. As suggested by Lincoln and Guba (1985, p. 307) credibility in this study was obtained by having two different investigators to interpret and assess the data material in **paper III** and **IV**.

In the process of writing this thesis I made notes during data collection and in the process of the counselling. These notes have provided valuable material for reflection. As Heath and Hindmarsh (2002) suggest, the researcher has to provide field work to know the context and culture. My background as a faculty member and working with simulation in nursing education for many years has been important in knowing the culture and context.

To minimize distortion, the process of analysis and interpretation has been conducted over a long period of time in order to attain both distance and proximity to the data. Although establishing trust can never be guaranteed (Lincoln & Guba, 1985, p. 303), teachers must always be aware that building a safe learning environment is an important condition for learning. In the subsequent study, my role in the simulation event was peripheral, and not involved in the facilitation of the nursing students. Efforts to obtain trustworthiness (ibid. p. 304) have been described in detail in section 5.8, *Data analysis,* and in the papers. As recommended by Jordan and Henderson (1995), the video-recordings and data analysis in **Paper I** and **II** were presented to shared watching discussions and analysis in various seminars and workshops (cf. section 5.8.1 *Interaction analysis*).

5.9.2 *Transferability*

Lincoln and Guba (1985) suggest that transferability is dependent upon the degree of similarity between two contexts. They point out that it is the researchers' responsibility to provide the database that makes transferability judgements possible on the part of potential appliers. Studying conditions for learning team-based resuscitation in simulation practice in nursing education is interesting knowledge from a pedagogical view. If this knowledge is limited to only nursing students participating in the study, the benefits will be very small. If the results have validity beyond the case under scrutiny, the explanation in section 5.2 *Participants* that 89% of the sample were females has to be taken into account. Further, the explanation of the setting and time in section 5.3 *The setting* can only make assumptions about transferability of the research (Lincoln & Guba, 1985, p. 316).

5.9.3 *Dependability*

Credibility requires dependability (Lincoln & Guba, 1985). Peräkylä (2004) uses the term 'reliability' but according to Lincoln and Guba (1985) the concept of 'dependability' is equivalent to 'reliability' in qualitative research. Peräkylä (2004) suggests that the three most important criteria for dependability (reliability) in naturally occurring interaction concern:

1) the choice of what is recorded on video
2) the technical quality of recordings
3) whether or not transcripts are sufficient

The choice of what should be recorded on video was taken at an early stage in the current study. The decision to tape-record all three phases of the simulation event was done after formulating the overall aim and research questions of the study. To get an overall picture of what was going on in the simulation event it was necessary to record the entire simulation, moment by moment. Since Interaction Analysis develops inductively (**paper I** and **II**), I did not initially know what phenomenon that would be studied (Peräkylä, 2004). In order to observe the variation of the phenomenon in a dependable manner, I needed a large collection of cases: in total 14 briefings and 28 simulation scenarios and debriefings. This large database was used as a resource when I had a clearer view of the phenomenon of central concern. As Peräkylä (2004) suggested, I included the verbal utterances (**paper I, II** and **III**) and non-verbal explanations in the transcription (**paper I** and **II**). To achieve appropriate technical quality of recordings and thereby dependability, I used a separate audio-recorder in addition to the permanently installed audio-video equipment. To ensure the transcripts were sufficient, a standardized transcription system was used in **paper I** and **II** (cf. section 5.7.1 *Transcription of the video recordings*) (Heath & Hindmarsh, 2002; Peräkylä, 2004). In **paper III**, the audio-recordings were reviewed numerous times to achieve an accurate transcription of the conversation. The same approach was used in **paper IV**, where the video-recordings were reviewed repeatedly to achieve an accurate assessment of the students' performance of D-CPR.

Relevant to **paper I** and **II** in the understanding of the interaction, the interacting participants refer to each other's interpretations of what is going on, and especially to what was going on in the previous turn, referred to as "Validation through next turn" (Peräkylä, 2011, p. 368). This recognition raises a basic validation procedure used in all Interaction Analysis (IA) research:

> But while understandings of other turn's talk are displayed to co-participants, they are available as well to professional analysts, who are thereby afforded a proof criterion....for the analysis of what a turn's talk is occupied with (Sacks et al., 1974, p. 729)

Any interpretation that an IA analyst suggests can be tested in relation to the validation procedure suggested by Sachs: the next turn will show whether the participants in the interaction manage the action in a manner consistent with the researcher's interpretation. Usually, the next turn in the interpretation work is ambiguous in relation to the previous turn, yet it is Sachs' procedure that should be applied. In IA, recordings and transcripts are 'raw material' and therefore dependability closely relates to the accuracy of the data material and access to their production (Silverman, 2006).

5.9.4 *Conformability*

Conformability requires one to show the way in which interpretations have been arrived at via the inquiry (Lincoln & Guba, 1985). For Lincoln and Guba (1985) conformability is established when credibility, transferability and dependability are achieved. In this study, efforts to meet the demands on conformability have been made previously describing in detail all steps of the research process in this chapter.

6 Summary of the results

The main findings of each of the four studies constituting this thesis are presented below. **Paper I** is concerned with how to prepare nursing students in the briefing for team-based cardiac arrest simulation, while **paper II** concerns how nursing students coordinate simulated resuscitation teamwork. **Paper III** explores the levels of reflection in debriefings based on conversations between facilitators and nursing-student teams regarding leadership in teamwork. In **paper IV** we investigate the extent to which nursing students follow the D-CPR guidelines and if different conditions in simulation change subsequent performance of D-CPR. The first three papers are qualitative studies, and the last one is quantitative.

6.1 Paper I

Instructional problems in briefings: How to prepare nursing students for simulation-based cardiopulmonary resuscitation training

The aim was to explicate instructional problems in the briefing focusing on how nursing students understand the actions which should be performed in cardiac arrest and how these should be adapted to the specific conditions of the simulation. The findings reveal three types of tasks that were consistently problematic for all nursing students to understand and master and that facilitators dealt with in every briefing: 1) Taking the correct position, 2) Keeping airways open, 3) Ventilating with a bag-mask. To further improve simulation-based environments as an arena for training crucial aspects of resuscitation teamwork, it is important that facilitators take into account how the briefing can bridge the gap between simulation and clinical practice. This can be achieved by systematically using not only the nursing students' *claimed* understandings but also their *exhibited* understandings for the correction of their performance in team-based resuscitation. If the simulation setting presupposes a higher level of skills (e.g. application of bag-mask) than expected in nursing education (in Norway), this adds unnecessary ambiguity and complexity that might interfere with opportunities to learn from simulation experiences.

6.2 Paper II

Educating for teamwork- nursing students' coordination in simulated cardiac arrest situations

The overarching aim was to explore and describe the interplay of communicative modes nursing students employ to coordinate the team in a simulation-based environment designed for resuscitation-team training. Previous research has emphasized the need for verbal communication to maintain effective coordination in resuscitation teams. Three phases of coordination in the resuscitation team were identified: Stating unconsciousness, Preparing for resuscitation, and Initiating resuscitation. Coordination of joint assessments and actions in these phases involved a broad range of verbal and nonverbal communication modes that were necessary for achieving mutual understandings of how to continue to the next step in the algorithm. This was accomplished through a complex interplay of taking position, pointing, and through verbal statements and directives. The conclusion was that non-verbal modes are of vital importance in coordination of resuscitation teams. Further, simulation practice offers a promising solution to nursing education in training the coordination necessary within resuscitation teams as it provides the opportunity to practice the complex interplay of verbal and non-verbal communication modes that would otherwise not be possible.

- A condition for effective coordination in teams is a combination of verbal and non-verbal modes
- Simulation is beneficial for training resuscitation teams
- Verbal and non-verbal coordination modes in teams should be trained in nursing education
- Research should focus on how verbal and non-verbal modes are intertwined in coordinated teamwork

6.3 Paper III

Reflection on leadership in resuscitation teamwork in post-simulation debriefing in nursing education

The aim of this study was to explore the practice of debriefing with a focus on conversations between facilitators and nursing students about leadership in resuscitation teamwork. The results of the study revealed three main categories: the role and responsibilities of the leader, the tasks of the leader and the role of the team members. Facilitators accounted for most of the talking and mostly asked descriptive and verifying/confirming questions, while nursing student mostly responded with descriptive replies. Nevertheless, the facilitators' descriptive questions also elicited student responses on a more reflective level. The debriefings promote nursing students to reflect on their simulation experience and to articulate new understanding of the simulation event. To optimize promotion of reflection, it is vital for the facilitators to provide sufficient space for nursing students' articulation of experiences and to formulate questions on a reflective level.

6.4 Paper IV

A comparative study of defibrillation and cardiopulmonary resuscitation performance during simulated cardiac arrest in nursing student teams

The aim of this study was to investigate the extent to which nursing student teams follow the D-CPR-algorithm in a simulated cardiac arrest, and if observing a simulated cardiac arrest scenario and participating in the post simulation debriefing would improve subsequent team performance. Conditions for Group A was to perform D-CPR in a simulated cardiac arrest scenario, while conditions for Group B was to perform D-CPR after first observing performance of Group A and participating in the debriefing. Overall, there were large variations in how accurately the nursing-student teams performed the specific parts of the D-CPR algorithm. While few teams performed opening the airways and examination of breathing correctly, all teams used a 30:2 compression: ventilation ratio. We found no difference between Group A and Group B in D-CPR performance, either in regard to total points on the check list or to time variables. We found that none of the nursing student teams achieved top scores on the D-CPR-checklist. Observing the training of other teams did not increase subsequent performance. The results indicate that more time must be assigned for repetitive practice and reflection. Moreover, the most important aspects of D-CPR, such as early defibrillation and hands-off time in relation to shock, must be highlighted during team-training of nursing students.

6.5 Summary of the findings

The findings of the four studies highlight a range of central conditions that are critical for learning in simulation practice: instructions in the briefing are of vital importance to bridge the gap between simulation and clinical practice. This can be achieved by using the students' exhibited understanding of how to perform team-based resuscitation for correction of their performance, providing that skills included in the simulation scenario are mastered in advance and in line with the specific educational level of the nursing programme. Simulated D-CPR performance in nursing-student teams requires repetitive practice, and early defibrillation and hands-off time in relation to shock must be highlighted during the debriefing. Nursing students' reflection has to be secured in debriefing by formulating questions on a reflective level and providing sufficient space for students' articulation of experiences.

Further, the findings suggest that simulation practice offers a promising solution to nursing education for training the necessary coordination in team-based resuscitation, as this practice provides the opportunity to practice the complex interplay of verbal and non-verbal communication modes that would otherwise not be possible. Moreover, performance of nursing-student teams in simulation practice demonstrated that the students achieved two-thirds of the D-CPR checklist points. Observing the training of other teams and participating in one debriefing did not increase subsequent performance.

7 Discussion

Each of the papers herein provides a significant contribution to focusing on critical conditions for learning. By investigating all phases of simulation, the combined effect of these studies is to show how the framing of the simulation, the scenario itself and the students' reflections of their experiences all involve conditions of critical importance for their possibility to gain from their experiences. In addition, the last study reveals that simulating resuscitation is initially a demanding task to master, which can be understood against the background of the complexity revealed in the preceding studies.

The results presented in **paper I** demonstrate how the students understanding of the approaching simulation scenario are created in and through the participants' interaction in the briefing. The simulation-based environment itself functions as a resource for instruction of how and what is going to be simulated, but also as an environment for the correction of the students' exhibited understanding of tasks that have to be performed in the subsequent simulation scenario. The study shows that there is a need for competent support and guidance by facilitators in the briefing phase for students to bridge between the conditions for how tasks should be performed in clinical practice and the prerequisites for performing a resembling task in the simulation environment. In contrast to previous literature and research in simulation (Jeffries, 2007; Miller et al., 2008; Nehring, 2010; Rhodes & Curran, 2005) the results of this study point to the briefing as a much more critical activity for creating understanding of what the simulation is actually simulating.

Paper II shows how non-verbal and verbal communication modes are intertwined in coordination of simulated resuscitation teamwork and how simulation-based environments offer possibilities for training important facets of teamwork that would not otherwise be possible. The results support previous studies which show that the simultaneous use of verbal and non-verbal modes is a prevalent coordination mechanism in anaesthesia teams (Manser, et al., 2008). However, the findings of this study differ from previous research on coordination within teams, which suggest that verbal modes alone or verbal- and non-verbal modes as separate entities can explain how coordination is achieved (Cooper & Wakelam, 1999; Xiao & Group, 2001). In this way, the present study adds an important dimension to established training programs such as Crew Resource Management (CRM), in which only verbal modes are emphasized as the cornerstone for communication and coordination in team performance (Rall & Dieckmann, 2005).

In **Paper III** the results point to the significance of optimizing nursing students' reflection in the debriefing by formulating questions on a reflective level and providing sufficient space for students' articulation of their experiences. The results are in accordance with previous research demonstrating that reflection in the debriefing is of vital importance for the students to develop and integrate insights from direct experience into later action (Atkins & Murphy, 1993; Dreifuerst, 2009; Leonard et al., 2010).

Finally, **paper IV** demonstrates that one single simulation is not sufficient for students to perform correct D-CPR and that observing training of other teams and participating in the debriefing does not in itself improve performance. The results confirm previous research showing that healthcare professionals and students need repetitive practice and feedback to perform D-CPR perfectly (Issenberg, et al., 2005; Linnard-Palmer, 1996; Oermann, et al., 2011; Sutton et al., 2011). Issenberg et al.'s review (2005) about the use of simulation to support learning found that feedback and repetitive practice were the two most important features to facilitate learning.

In the following discussion, the results of the four papers from the three phases of simulation will be considered in the light of the core concepts presented in the theory chapter. Analytic attention will firstly be given to how simulation provides an arena for nursing students' *participation*, secondly to how simulators can function as *mediating tools* for learning and, thirdly, to how *social order* is established and accounted for in simulations.

7.1 Simulation practice as an arena for participation

The results show that simulation practice provides a learning environment for participation that is safe for patients in the sense that no patients are harmed. The environment also allows for nursing students to make mistakes that can be corrected and possibilities for exposure to clinical experiences they rarely encounter during clinical training, such as (simulated) cardiac arrest. In terms of Lave and Wenger (1991), simulations serve as arenas for legitimate peripheral participation.

As mentioned earlier, Johnson (2007) has examined a form of participation in simulation practice which she calls ‘reconstituting’ medical practice (p. 593). Johnson demonstrates how simulations of medical practice are interactively established by reconstituting patients’ and surgeon’s bodies. This reconstitution was enabled through the instructor’s explanation and by simultaneously directing the students’ visual orientation. In a similar way, the results of **paper I** demonstrate that the kind of participation simulation practice offers is related to how the nursing students are shown how a team leader should be positioned, how they are instructed to execute tasks, and how to link their knowledge about clinical procedures to the patient’s body (Hindmarsh, 2010). One major conclusion to be drawn from **paper I** is that it is of crucial importance that the facilitator demonstrates care and treatment of a patient with cardiac arrest in such a way that the various representations of clinical practice in the simulation environment stand out as meaningful in relation to the nursing students’ prior knowledge. Similarly, it is of central importance that the nursing students’ understanding of the subject matter becomes accessible for the facilitator. In this manner, the facilitator can contribute to making connections between simulation practice and clinical practice. In **paper I**, this connection is achieved through the facilitator’s explanation of the execution of the simulation and by simultaneously assessing and correcting the student’s exhibited understanding, which rests on the students’ bodily displayed competence (or lack thereof). When the nursing student displays the problem of bag-mask ventilation (which implies a higher educational level than expected), this poses some challenges in terms of differentiating between the specific features of simulation practice and clinical practice. The instructor's downplaying of the problem leaves the students to make their own understanding and interpretations of what the simulation is simulating. In Johnson (2007), this problem of participation was solved by the instructor's verbal guidance in combination with bodily conduct until the students displayed their exhibited understanding of the task. In doing so, the instructor set the scene for participating in the situation during the subsequent scenario.

Paper II demonstrates how the patient simulator in the simulation scenario is treated as an instance of its real counterpart, which serves as a condition for paralleling participation in clinical activities. The nursing students participate in the activity on the basis that the patient simulator is a representation of a human being or a stand-in for the patient (cf. Johnson, 2007). For instance, this is shown in how the nursing students coordinate the resuscitation team by acting as nurses at the workplace and caring for the patient simulator as if it was a real patient (Dieckmann, et al., 2007). Throughout all the scenarios, the students use the patient's forename when they check for response and refer to the simulator as a patient, for example, by saying "she is not breathing". In line with Johnson (2007) the findings of **paper II** reveal that this kind of participation offers possibilities to learn how to coordinate, ascertain and deal with a patient who goes into cardiac arrest. In this way, clinical practice is made relevant in the simulation and points to how a reconstitution of a specific type of participation is employed to approach the conditions in clinical practice.

In **paper III**, where the aim was to grade questions and responses in criteria of reflection in the debriefing, the findings reveal that the facilitators and nursing students discussed the students' performance in the simulation scenario in terms of how the tasks should be executed in a real situation. In the debriefings they regularly related their participation in the simulation activities to how proper performance should be achieved in exemplary clinical practice. Moreover, their responses involved reflections on their intended actions in prospective events that they could encounter at work. One might say that the facilitators and nursing students 'reconstituted' the debriefing as a kind of clinical practice by relating to the previous conduct as having implications for their future identities as nurses (Johnson, 2007).

7.2 Simulators as mediating artefacts in learning

From a socio-cultural perspective, simulators are artefacts that serve as instances of mediating artefacts in learning activities (Säljö, 2008). **Paper I** shows that the simulator and other physical artefacts are essential for how the participants engage in activities in the briefing of how to perform team-based resuscitation in the subsequent simulation scenario. There are several ways in which the artefacts seem to do this. For instance, the artefacts involved— especially the mannequin — serve as a means for demonstration of the spatial position of the team leader. The simulator-as-artefact cannot support this task in itself, and guiding seems to be a crucial prerequisite for the nursing students' understanding of how they should frame the task to be performed (Rystedt & Lindwall, 2004).

A second way in which artefacts become a part of the briefing is in the students' exhibited understanding of how to position the oral airway in the patient simulator's mouth, serving as a basis for the facilitator's corrections. A third is when the student faces the problem of ventilating the simulator with a bag-mask. In this situation it is apparent that the student receives feedback from the mask's contact surface with the simulator that air is leaking, which, in turn, is interpreted by the student as a problem of force. The facilitator uses this shared understanding of the problem to further instruct the students on how much force is needed to squeeze the bag. This illustrates that the artefacts are a constitutive part of the learning situation in which the facilitator and nursing students operate.

Paper II points to the significance of artefacts (patient simulator and medical devices) most importantly as a constitutive part of the nursing students' verbal and non-verbal interaction in coordinating their action. One of the ways in which this is done, is when the patient simulator is part of the activity but does *not* respond to the students' verbal- and non-verbal request. Notable here is that the operator via the patient simulator gives feedback to the student by *not* responding. Another way in which an artefact mediates the activity is when the students are able to align with each others' actions by directing shared attention to the mannequin. For example, when the cessation of the chest heaves functions as a shared point of reference to move on to the next step in the algorithm.

Similarly, **paper III** demonstrates that the simulator and the other artefacts become a basis for reflection in the debriefing. This was enacted in various ways, primarily in how the simulator was a central part of the students' reflection (Johnson 2007) on actions concerning communication with the patient, for example "he (the doctor) asked about the patient's respiration". The artefacts were also a central part of the students' reflections on executing tasks such as inserting the oral airway, connecting the oxygen and monitoring vital signs "[….] while you were talking to the patient and trying to monitor the pulse". The simulator was also central in the facilitators' questions concerning the spatial position of the leader of the team: "could you have seen another position you could have put yourself in other than doing chest compressions?"(on the patient). To conclude, the simulator and other artefacts formed the basis for reflection on action in the debriefing (Boud, et al., 1985). Most of the nursing students' responses referred to their interaction with artefacts as a central part of the activity and some of these enabled questions and responses on higher levels of reflection.

Paper IV provides an instance of how simulators and other artefacts were central in the assessment of the nursing students' D-CPR exhibited understanding through their performance (cf. Hindmarsh et al., 2011). Assessment of the students' success was made by looking at how they used the simulator-as-artefact to check for responses and breathing. The simulator was also used to assess how the nursing students applied (or did not apply) other artefacts, such as medical devices, in relation to the simulator to perform tasks. In this way, the artefacts became central to the activity in the sense that they contributed to checking student accuracy in performing D-CPR (Kromann et al., 2009).

7.3 Establishing and accounting for social order in simulations

This thesis involves an interest in how social order is both established and accounted for in simulation activities. The results reveal some of the 'taken – for – granted' or implicit rules immanent in constituting social order in social practices (Garfinkel, 1984). From an ethnomethodological perspective, there is a specific interest in how participants demonstrate in the *way* they do things *what* they are doing (ten Have, 2004, p. 152). The *accounts* refer back to how the actions of the participants are made intelligible to the others (ibid.). **Paper I**, for instance, shows how the facilitator instructed the nursing students: "You have to stand here, behind". By making the spatial position area an observable feature in its own right, the facilitator effectively displayed this position behind the bed as critical in coordinating the team rendering it visible as 'an account of an everyday action' (Garfinkel & Sacks, 1986). The message actions conveyed to the nursing students ensured the 'taken –for– granted' expectations in the subsequent simulation scenario. **Paper II** shows another instance of this, of how one nursing student visibly breaks the expected social order by positioning herself on the left side of the bed. The excerpts presented in section 5.8.1 reveal that the leader of the team re-constitutes the social order by directing the ventilation role to another student. It is taken for granted that the spatial position behind the bed is meant for this student, and not for the leader. In terms of Garfinkel (1967), social order is established and accounted for in simulation practice by the participants' (members') visual, interactional, and embodied competences, which are usually taken for granted – they are "seen but unnoticed" (p. 41).

Paper III points to how social order in the simulation scenario is accounted for during the debriefing. The content identified in the debriefing was mainly task and team leader oriented. By focusing on the team leader's role and tasks, the leader is held responsible for how the premises for social order in line with good clinical practice are constituted (Rystedt & Sjöblom, 2012). The 'taken – for– granted' rules reflected on in the debriefing can be formulated in this way:

- The team leader gives clear messages to the followers
- The team leader gets an overview by standing behind the bed
- The team leader distributes the tasks to the followers

Referring to the performance in the simulation and the principles for how good leadership should be employed makes the team leader retrospectively "visibly, observable and reportable for all practical purposes, i.e. accountable" (Garfinkel, 1967, p. vii). The role of the team leader, as accounted for in the debriefing, serves to inform the students that other team members should follow the direction of the team leader in team-based resuscitation. Moreover, it exemplifies how the nursing students struggle to constitute a functional social order in team-based resuscitation. This was visible in the student teams' performance of the D-CPR in the sense that coordination of actions was highly problematic, such as of those actions necessary for following the D-CPR-algorithm (cf. **Paper IV**). In contrast, the performance of discrete skills, such as performing chest compressions individually, was less problematic. Conducting the D-CPR-algorithm correctly presumes that a specific division of labour is constituted and implies that the students interactively need to display to each other the understanding of what has been done and thereby create a mutual understanding of what action has to be undertaken next.

7.4 Methodological reflections

The aim of this study has been to develop knowledge about the critical conditions for learning in simulation practice, and has been done in order to gain a better understanding of what goes on during a typical simulation activity in itself, i.e. in the 'black box' of simulation practice and the complexity inherent in those activities.

In the process of conducting this explorative and descriptive study, considerations was continuously given to whether or not the methods addressed the aims of the study (Blaikie, 2009). The starting point was the socio-cultural perspective, implying an interest in investigating how knowledge originates from participation in activities in social practices. After analysing the activities going on in the briefing (**paper I**) and simulation scenario (**paper II**), there was a growing interest in investigating the conditions necessary for promoting reflection by analysing the relationship between the facilitator's questions and nursing students' responses in the debriefing. This required a theory-driven content analysis and quantification of questions and answers. Last, but not least, there was an interest in observing to what extent the nursing students performed team-based D-CPR correctly in the simulation scenario, which required standardised coding and statistical analysis to draw conclusions.

7.5 Implications for educational practice

Several important conditions for learning in simulation practice must be taken into account in the planning, development and implementation of simulation in nursing education and other healthcare professions that use simulation to learn how to perform resuscitation.

Firstly, in the planning phase of simulation-based learning the faculty has to review the educational level of the students. This has to be done before identifying the learning objectives. Moreover, the faculty has to ensure that the nursing students are mastering the required skills in advance of the simulation event.

Secondly, the briefing has to be further developed as an interactive and student-active phase whereby the nursing students are encouraged to execute tasks in interaction with the simulator and medical devices under the guidance of a facilitator.

The briefing should be used to explicate the relevant similarities and irrelevant dissimilarities between the simulation's representation of real patients and clinical situations that the simulation is supposed to mimic. The relevant similarities relate to monitoring pulse, blood pressure and chest heaves, while the irrelevant dissimilarities relate to the fact that the simulator's skin and pupils cannot change and that you cannot feel airflow as a sign of breathing. The learners have to be instructed as to which procedures can or cannot be performed on the mannequin, how to execute these procedures, and how these are different from those performed on human beings. Since mouth-to-mouth and mouth-to-mask ventilation cannot be applied to the patient simulator, it is important to consider the introduction of another simulator in resuscitation training in nursing education.

Thirdly, this study contributes to an understanding of how the interplay between verbal and non-verbal communication modes is critical to conditions for effective coordination in teams. This finding implicates that verbal and non-verbal coordination modes in team-based resuscitation should be explicitly addressed in simulation training in nursing education. The detailed analysis of the interplay between verbal- and non-verbal modes can contribute to a better understanding of the premises for interaction between patients, nursing students, faculty and healthcare professions during resuscitation. In turn, this understanding can be used for communication training in simulation-based environments. Moreover, this study has shown that video recordings of simulations provide an appropriate method of practicing and raising awareness of the interplay between these communication modes.

Fourthly, facilitators need to encourage reflection in the debriefing and provide sufficient time for the nursing students to articulate their experience. This can be done by development of faculty programs based on Williams et al.'s (2000) model of grading reflection and focusing on facilitating the facilitators.

Last but not least, the results point to the significance of offering repetitive practice of D-CPR and feedback if students are to achieve the skills necessary for correct performance. This can be done by implementing D-CPR training throughout the entire nursing program and providing students with appropriate feedback and sufficient room for reflection.

This thesis shows how the implementation of technological tools such as patient simulators completely transforms the learning activities of traditional classroom instruction. The implementation of simulation-based learning in nursing education implies that new demands are made on both faculty and nursing students, such as a different pedagogical role for the faculty and a different role for the student in relation to the subject matter (e.g. team-based D-CPR). In addition, simulation-based environments offer a different and potentially more effective way of 'learning by doing' with new options as well as new problems that have to be addressed.

7.6 Suggestions for future research

On the basis of the implications for nursing education, the thesis points to several areas for further research, a few of which are mentioned below. Although the results bring attention to several important conditions for learning, it will be of special interest to investigate more specifically what the conditions for learning in the briefing mean for the subsequent scenarios.

There is also a need for more research on how to bridge the gap between simulation practice and clinical practice, focusing on both differences and similarities between simulation and reality. One aspect pertains to how the participants learn *how to simulate*, another to how the participants' interaction upholds the simulation as a simulation of specific professional aspects of clinical practice. Future research should focus on how verbal and non-verbal communication modes are intertwined in coordinated resuscitation teamwork. This research may serve as a basis for developing pedagogical models which further focus on communication and interaction in healthcare teams. Accordingly, such models could be developed to replace prevailing models such as CRM, which is based on interaction between very few team members compared to resuscitation teams. More research is also needed on how reflection can be achieved in the debriefing by focusing on the content of reflective questions and the responses they obtain from the learners.

8 Conclusion

This thesis has contributed to the understanding of what goes on in the ‘black box’ of simulation practice in nursing education. The study demonstrates that the simulation-based environment is a very complex one for the nursing students to master as they must deal with both the specific conditions in this simulation-based learning environment and the tasks to be managed in resuscitation. The results of the study point to several critical conditions that are important if the learning objectives in the simulation are to be achieved. Firstly, it is of vital importance that the facilitator’s instruction does not lead to confusion regarding what the simulation is simulating. Secondly, it is important that guidance and correction of tasks is provided by the facilitator. Thirdly, to achieve coordination of resuscitation teamwork, the interplay between non-verbal and verbal communication modes must be trained and emphasized in the simulation. Fourthly, optimizing nursing students’ reflection in the debriefing requires questions on a reflective level, and fifthly, accurately team-based D-CPR performance in nursing education requires repetitive practice and feedback.

References

Alinier, G. (2007). A typology of educationally focused medical simulation tools. *Medical Teacher, 29*(8), 243-250.

Alinier, G., Hunt, B., Gordon, R., & Harwood, C. (2006). Effectiveness of intermediate-fidelity simulation training technology in undergraduate nursing education. *Journal of Advanced Nursing, 54*(3), 359-369.

Atkins, S., & Murphy, K. (1993). Reflection: a review of the literature. *Journal of Advanced Nursing, 18*(8), 1188-1192.

Badger, T., & Rawstorne, D. (1998). An evaluative study of pre-registration nursing students' skills in basic life support. *Nurse Education Today, 18*(3), 231-236.

Bailey, C., Johnson-Russell, J., & Lupien, A. (2010). High-Fidelity Patient Simulation. In A. J. Lowenstein & M. J. Bradshaw (Eds.), *Innovative teaching strategies in nursing and related health professions* (pp. 207-226). Sudbury, Mass.: Jones and Bartlett Publishers.

Bassendowski, S. L. (2007). Educational innovations. NursingQuest: supporting an analysis of nursing issues. *Journal of Nursing Education, 46*(2), 92-95.

Bearnson, C. S., & Wiker, K. M. (2005). Human patient simulators: a new face in baccalaureate nursing education at Brigham Young University. *The Journal Of Nursing Education, 44*(9), 421-425.

Bennet, B. S. (1995). *Simulation fundamentals*. Hempstead: NJ: Prentice Hall International.

Blaikie, N. (2009). *Designing social research: the logic of anticipation*. Cambridge: Polity Press.

Boud, D., Walker, D., & Keogh, R. (1985). Promoting reflection in learning: A model. In D. Boud, D. Walker & R. Keogh (Eds.), *Reflection: turning experience into learning* (pp. 18-40). London: Kogan Page.

Bradley, P. (2006). The history of simulation in medical education and possible future directions. *Medical Education, 40*(3), 254-262.

Bradshaw, A., & Merriman, C. (2008). Nursing competence 10 years on: fit for practice and purpose yet? *Journal of Clinical Nursing, 17*(10), 1263-1269.

Brannan, J. D., White, A., & Bezanson, J. L. (2008). Simulator effects on cognitive skills and confidence levels. *Journal of Nursing Education, 47*(11), 495-500.

Bremner, M. N., Aduddell, K., Bennett, D. N., & VanGeest, J. B. (2006). The use of human patient simulators: best practices with novice nursing students. *Nurse Educator, 31*(4), 170-174.

Brown, S. T., Kirkpatrick, M. K., Greer, A., Matthias, A. D., & Swanson, M. S. (2009). The use of innovative pedagogies in nursing education: an international perspective. *Nursing Education Perspectives, 30*(3), 153-158.

Bruce, S. A., Scherer, Y. K., Curran, C. C., Urschel, D. M., Erdley, S., & Ball, L. S. (2009). A Collaborative Exercise: Between Graduate and Undergraduate Nursing Students Using a Computer-Assisted Simulator in a Mock Cardiac Arrest. *Nursing Education Perspectives, 30*(1), 22-27.

Cannon-Diehl, M. R. (2009). Simulation in healthcare and nursing: state of the science. *Critical Care Nursing Quarterly, 32*(2), 128-136.

Cant, R. P., & Cooper, S. J. (2010). Simulation-based learning in nurse education: systematic review. *Journal of Advanced Nursing, 66*(1), 3-15.

Carpico, B., & Jenkins, P. (2011). Resuscitation review to improve nursing performance during cardiac arrest. *Journal for Nurses in Staff Development, 27*(1), 7-12.

Childs, J. C., & Sepples, S. (2006). Clinical teaching by simulation: lessons learned from a complex patient care scenario. *Nursing Education Perspectives, 27*(3), 154-158.

Cooper, S., & Wakelam, A. (1999). Leadership of resuscitation teams: 'Lighthouse Leadership'. *Resuscitation, 42*(1), 27-45.

Creswell, J. W. (2012). *Educational research: planning, conducting, and evaluating quantitative and qualitative research*. Boston, Mass.: Pearson.

Davies, N., & Gould, D. (2000). Updating cardiopulmonary resuscitation skills: a study to examine the efficacy of self-instruction on nurses' competence. *Journal of Clinical Nursing, 9*(3), 400-410.

Decker, S. (2007). Simulations: Education and Ethics. In P. R. Jeffries (Ed.), *Simulation in nursing education: from conceptualization to evaluation* (pp. 11-19). New York: National League for nursing.

Dieckmann, P. (2009). *Using simulations for education, training and research*. Lengerich: Pabst.

Dieckmann, P., Gaba, D., & Rall, M. (2007). Deepening the theoretical foundations of patient simulation as social practice. *Simulation In Healthcare: Journal Of The Society For Simulation In Healthcare, 2*(3), 183-193.

Dreifuerst, K. T. (2009). The essentials of debriefing in simulation learning: a concept analysis. *Nursing Education Perspectives, 30*(2), 109-114.

Durham, C. F., & Alden, K. R. (2008). Enhancing Patient Safety in Nursing Education Through Patient Simulation. In R. G. Hughes (Ed.), *Patient*

Safety and Quality: An Evidence-Based Handbook for Nurses: Vol 3 (pp. 221-258). Rockville, MD: AHRQ Publication No. 08-0043 Rockville, MD: Agency for Healthcare Research and Quality. .

Dysthe, O. (2001). *Dialog, samspel og læring [Dialogue, interaction and learning]*. Oslo: Abstrakt forlag.

Eva, K. W. (2010). The value of paradoxical tensions in medical education research. *Medical Education, 44*(1), 3-4.

Fanning, R. M., & Gaba, D. (2007). The Role of Debriefing in Simulation-Based Learning. *Simulation In Healthcare: Journal Of The Society For Simulation In Healthcare, 2*(2), 115-125.

Feingold, C. E., Calaluce, M., & Kallen, M. A. (2004). Computerized patient model and simulated clinical experiences: evaluation with baccalaureate nursing students. *Journal of Nursing Education, 43*(4), 156-163.

Flanagan, B. (2008). Debriefing: theory and technique. In R. H. Riley (Ed.), *Manual of simulation in healthcare* (pp. 155-170). Oxford: OUP Oxford.

Fleiss, J. L., Levin, B., & Paik, M. C. (2004). The Measurement of Interrater Agreement *Statistical Methods for Rates and Proportions* (pp. 598-626): John Wiley & Sons, Inc.

Fletcher, J. L. (1998). AANA Journal course: update for nurse anesthetists -- ERR Watch: anesthesia crisis resource management from the nurse anesthetist's perspective. *AANA Journal, 66*(6), 595-602.

Garfinkel, H. (1967). *Studies in ethnomethodology*. Englewood Cliffs, N. J.: Prentice-Hall.

Garfinkel, H. (1984). *Studies in ethnomethodology*. Cambridge: Polity Press.

Garfinkel, H., & Sacks, H. (1986). On formal structures of practical actions. In H. Garfinkel (Ed.), *Ethnomethodological studies of work* (pp. 160-184). London: Routledge & Kegan Paul.

Gherardi, S., & Nicolini, D. (2002). Learning the Trade: A Culture of Safety in Practice. *Organization, 9*(2), 191-223.

Goodwin, C. (2000). Practices of Color Classification. *Mind, Culture & Activity, 7*(1/2), 19-36.

Goodwin, C. (2001). Practices of seeing Visual analysis: an Ethnomethodological Approach. In T. Van Leeuwen & C. Jewitt (Eds.), *Handbook of visual analysis* (pp. 157-182). London: Sage.

Goodwin, C., & Heritage, J. (1990). Conversation Analysis. *Annual Review of Anthropology, 19*, 283-307.

Gordon, C. J., & Buckley, T. (2009). The effect of high-fidelity simulation training on medical-surgical graduate nurses' perceived ability to respond to patient clinical emergencies. *Journal of Continuing Education in Nursing, 40*(11), 491-500.

Granneman, S., & Conn, V. S. (1996). An Evaluation of the Effectiveness of Competency-Based Code Blue Education. *Journal of Nursing Staff Development, 12*(6), 283-288.

Greenblat, C. (1998). *Designing games and simulations: an illustrated handbook*. Newbury Park, CA: SAGE Publications.

Grif Alspach, J. (1995). *The Educational Process in Nursing Staff Development*. St. Louis: Mosby.

Grote, G., Zala-Mezö, E., & Grommes, P. (2004). The effects of different forms of co-ordination on coping with workload. In R. Dietrich & T. M. Childress (Eds.), *Group interaction in high risk environments* (pp. 39-54). Aldershot: Ashgate.

Hamilton, R. (2005). Nurses' knowledge and skill retention following cardiopulmonary resuscitation training: a review of the literature. *Journal of Advanced Nursing, 51*(3), 288-297.

Hammond, F., Saba, M., Simes, T., & Cross, R. (2000). Advanced Life Support: retention of registered nurses' knowledge 18 months after initial training. *Australian Critical Care, 13*(3), 99-104.

Handley, A. J., Koster, R., Monsieurs, K., Perkins, G. D., Davies, S., & Bossaert, L. (2005). European Resuscitation Council Guidelines for Resuscitation 2005: Section 2. Adult basic life support and use of automated external defibrillators. *Resuscitation, 67, Supplement 1*(0), S7-S23.

Heath, C., & Hindmarsh, J. (2002). Analysing interaction: Video, ethnography and situated conduct. In T. May (Ed.), *Qualitative research in action* (pp. 99-121). London: SAGE.

Heath, C., Hindmarsh, J., & Luff, P. (2010). *Video in Qualitative Research. Analysing Social Interaction in Everyday Life* (Vol. 1). Los Angeles: SAGE.

Hertel, J. P., & Millis, B. J. (2002). *Using Simulations to Promote Learning in Higher Education. An Introduction*. Sterling, Virginia: Stylus Publishing.

Hindmarsh, J. (2010). Peripherality, participation and communities of practice: examining the patient in dental training. In N. Llewellyn & J. Hindmarsh (Eds.), *Organisation, interaction and practice: studies in ethnomethodology and conversation analysis* (pp. 218-240). Cambridge: Cambridge University Press.

Hindmarsh, J., & Pilnick, A. (2002). The Tacit Order of Teamwork: Collaboration and Embodied Conduct in Anesthesia. *Sociological Quarterly, 43*(2), 139-164.

Hindmarsh, J., Reynolds, P., & Dunne, S. (2011). Exhibiting understanding: The body in apprenticeship. *Journal of Pragmatics, 43*(2), 489-503.

Hoffmann, R. L., O'Donnell, J. M., & Kim, Y. (2007). The Effects of Human Patient Simulators on Basic Knowledge in Critical Care Nursing with Undergraduate Senior Baccalaureate Nursing Students. *Simulation in Healthcare: The Journal of the Society for Simulation in Healthcare, 2*(2), 110-114.

Hovancsek, M. T. (2007). Using Simulation in Nursing Education. In P. R. Jeffries (Ed.), *Simulation in nursing education: from conceptualization to evaluation* (pp. 1-9). New York: National League for nursing.

Hravnak, M., Beach, M., & Tuite, P. (2007). Simulator technology as a tool for education in cardiac care. *Journal of Cardiovascular Nursing, 22*(1), 16-24.

Husebø, S. E., & Rystedt, H. (2010). Simulering innen helsefag [Simulation in healthcare education]. In K. Aase (Ed.), *Pasientsikkerhet: teori og praksis i helsevesenet [Patient safety: theory and practice in healthcare]* (pp. 155-171). Oslo: Universitetsforl.

Hyland, J. R., & Hawkins, M. C. (2009). High-fidelity human simulation in nursing education: a review of literature and guide for implementation. *Teaching & Learning in Nursing, 4*(1), 14-21.

ICN. (2011). Code of Etics for Nurses. from http://www.icn.ch/about-icn/code-of-ethics-for-nurses/ (retrieved 15.03.12)

IOM. (2003). Health Professions Education: A Bridge to Quality. from www.iom.edu (retrieved 7.11.11)

Issenberg, S. B., McGaghie, W. C., Petrusa, E. R., Gordon, D. L., & Scalese, R. J. (2005). Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review. *Medical Teacher, 27*(1), 10-28.

Jeffries, P. R. (Ed.). (2007). *Simulation in nursing education: from conceptualizations to evaluation*. New York: National League for Nursing.

Jensen, K. T. (2006). *Å være student i en feltbasert utdanning: en analyse av studenters fellesskap, som kontekst for læring og identitetsdannelse [Being a student in a field-based education: an analysis of students' community, as a context for learning and identity formation]. Doctoral dissertation.* Unipub forl., Oslo.

Johnson-Russell, J., & Bailey, C. (2010). Facilitated Debriefing. In F. R. Lashley & W. M. Nehring (Eds.), *High-fidelity patient simulation in nursing education* (pp. 369-385). Sudbury, Mass.: Jones and Bartlett Publishers.

Johnson, B., & Christensen, L. B. (2011). *Educational research: quantitative, qualitative, and mixed approaches*. Los Angeles: Sage.

Johnson, E. (2004). *Situating simulators: the integration of simulations in medical practice. Doctoral dissertation.* Arkiv förlag, Lund.

Johnson, E. (2007). Surgical simulators and simulated surgeons: Reconstituting medical practice and practitioners in simulations. *Social Studies of Science, 37*(4), 585-608.

Jordan, B., & Henderson, A. (1995). Interaction Analysis: Foundations and Practice. *Journal of the Learning Sciences, 4*(1), 39.

Kantor, S. A. (2010). Pedagogical change in nursing education: one instructor's experience. *Journal of Nursing Education, 49*(7), 414-417.

Kardong-Edgren, S. E., Starkweather, A. R., & Ward, L. D. (2008). The integration of simulation into a clinical foundations of nursing course: student and faculty perspectives. *International Journal of Nursing Education Scholarship, 5*(1), 1-16.

Kohn, L. T., Corrigan, J., & Donaldson, M. S. (2000). *To err is human: building a safer health system*. Washington, D.C.: National Academy Press.

Krippendorff, K. (2004). *Content analysis: an introduction to its methodology*. Thousand Oaks, Calif.: Sage.

Kromann, C. B., Jensen, M. L., & Ringsted, C. (2009). The effect of testing on skills learning. *Medical Education, 43*(1), 21-27.

Kvale, S., Nielsen, K., Bureid, G., & Jensen, K. (1999). *Mesterlære: læring som sosial praksis [Apprenticeship learning-learning as social practice]* Oslo: Ad Notam Gyldendal.

Kyrkjebø, J. M., Brattebø, G., & Smith-Strøm, H. (2006). Improving patient safety by using interprofessional simulation training in health professional education. *Journal of Interprofessional Care, 20*(5), 507-516.

Lashley, F. R., & Nehring, W. M. (2010). *High-fidelity patient simulation in nursing education*. Sudbury, Mass.: Jones and Bartlett Publishers.

Lau, Y., Nagammal, S., & Kiat, T. K. (2010). Planning and creating a Scenario: The Institute of Technical Education Experience. In F. R. Lashley & W. M. Nehring (Eds.), *High-fidelity patient simulation in nursing education* (pp. 323-339). Sudbury, Mass.: Jones and Bartlett Publishers.

Lave, J., & Wenger, E. (1991). *Situated learning: legitimate peripheral participation*. Cambridge: Cambridge University Press.

Leighton, K., & Johnson-Russell, J. (2010). Innovations in Facilitating Learning using Simulation. In A. Bradshaw & A. J. Lowenstein

(Eds.), *Innovative Teaching Strategies in Nursing and Related Health Professions* (pp. 239-264). Sudbury: Jones and Barlett Publishers.

Leonard, B., Shuhaibar, E. L. H., & Chen, R. (2010). Nursing Student Perceptions of Intraprofessional Team Education Using High-Fidelity Simulation. *Journal of Nursing Education, 49*(11), 628-631.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, Calif.: Sage.

Lindblad, S. (1976). *Simulering i undervisning: en kritisk granskning av artificiell praktik i allmänutbildning. [Simulation in teaching: a critical review of artificial practice in public education]. Doctoral dissertation.* University of Uppsala, Uppsala.

Linnard-Palmer, L. (1996). *The effect of a skills algorithm on nursing students' response rate, skill accuracy, and reported attention management during simulated cardiopulmonary arrests. Doctoral dissertation.* University of San Francisco, San Francisco.

Long, R. E. (2005). Using simulation to teach resuscitation: an important patient safety tool. *Critical Care Nursing Clinics of North America, 17*(1), 1-8.

Lov om helsepersonell. Lov av 2. juli 1999 nr. 64. [The Norwegian Health Personnel Act].

Lynch, M. (1993). *Scientific practice and ordinary action: ethnomethodology and social studies of science*. Cambridge: Cambridge University Press.

Madden, C. (2006). Undergraduate nursing students' acquisition and retention of CPR knowledge and skills. *Nurse Education Today, 26*(3), 218-227.

Malterud, K. (2011). *Kvalitative metoder i medisinsk forskning: en innføring [Qualitative methods in medical research: an introduction]* Oslo: Universitetsforl.

Manser, T., Howard, S. K., & Gaba, D. M. (2008). Adaptive coordination in cardiac anaesthesia: a study of situational changes in coordination patterns using a new observation system. *Ergonomics, 51*(8), 1153-1178.

Mastrian, K. G., McGonigle, D., Mahan, W. L., & Bixler, B. (2011). *Integrating technology in nursing education: tools for the knowledge era*. Sudbury, Mass.: Jones and Bartlett.

McCausland, L. L., Curran, C. C., & Cataldi, P. (2004). Use of a human simulator for undergraduate nurse education. *International Journal Of Nursing Education Scholarship, 1*, Article 23.

McMullan, M., Endacott, R., Gray, M. A., Jasper, M., Miller, C. M. L., Scholes, J., et al. (2003). Portfolios and assessment of competence: a review of the literature. *Journal of Advanced Nursing, 41*(3), 283-294.

McNamara, M. S. (2010). Where is nursing in academic nursing? disciplinary discourses, identities and clinical practice: a critical perspective from Ireland. *Journal of Clinical Nursing, 19*(5-6), 766-774.

Medley, C. F., & Horne, C. (2005). Educational innovations. Using simulation technology for undergraduate nursing education. *Journal of Nursing Education, 44*(1), 31-34.

Mekki, T. E., & Tollefsen, S. (2000). *På terskelen: introduksjon til sykepleie som fag og yrke [At the threshold: introduction to nursing as a discipline and profession]*. Oslo: Akribe.

Miller, K. K., Riley, W., Davis, S., & Hansen, H. E. (2008). In situ simulation: a method of experiential learning to promote safety and team behavior. *Journal of Perinatal & Neonatal Nursing, 22*(2), 105-113.

Monti, E. J., Wren, K., Haas, R., & Lupien, A. E. (1998). The use of an anesthesia simulator in graduate and undergraduate education. *CRNA: the Clinical Forum for Nurse Anesthetists, 9*(2), 50-66.

Moyer Childress, R., Jeffries, P. R., & Feken Dixon, C. (2007). Using collaboration to enchance the effectiveness of simulated learning in nursing education. In P. R. Jeffries (Ed.), *Simulation in nursing education: From conceptualization to evaluation* (pp. 123-135). New York: National League for Nursing.

Mullan, B. A., & Kothe, E. J. (2010). Evaluating a nursing communication skills training course: the relationships between self-rated ability, satisfaction, and actual performance. *Nurse Education in Practice, 10*(6), 374-378.

Nagle, B. M., McHale, J. M., Alexander, G. A., & French, B. M. (2009). Incorporating scenario-based simulation into a hospital nursing education program. *Journal of Continuing Education in Nursing, 40*(1), 18-27.

Nehring, W. M. (2010). History of Simulation in Nursing. In W. M. Nehring & F. R. Lashley (Eds.), *High-Fidelity Patient Simulation in Nursing Education* (pp. 3-26). Boston: Jones and Barlett Publishers.

Nehring, W. M., Lashley, F. R., & Ellis, W. E. (2002). Critical incident nursing management: using human patient simulators. *Nursing Education Perspectives, 23*(3), 128-132.

O'Donnell, J., Fletcher, J., Dixon, B., & Palmer, L. (1998). Planning and implementing an anesthesia crisis resource management course for student nurse anesthetists. *CRNA: the Clinical Forum for Nurse Anesthetists, 9*(2), 50-58.

Oermann, M. H., Kardong-Edgren, S. E., & Odom-Maryon, T. (2011). Effects of monthly practice on nursing students' CPR psychomotor skill performance. *Resuscitation, 82*(4), 447-453.

Overstreet, M. (2008). The use of simulation technology in the education of nursing students. *Nursing Clinics of North America, 43*(4), 593-603.

Pagano, M. P., & Greiner, P. A. (2009). Enhancing Communication Skills Through Simulations. In S. H. Campbell & K. M. daley (Eds.), *Simulation Scenarios for Nurse Educators. Making It Real.* (pp. 43-51). New York, USA: Springer Publishing Company.

Parker, B., & Myrick, F. (2010). Transformative learning as a context for human patient simulation. *Journal of Nursing Education, 49*(6), 326-332.

Parker, B. C., & Myrick, F. (2009). A critical examination of high-fidelity human patient simulation within the context of nursing pedagogy. *Nurse Education Today, 29*(3), 322-329.

Peräkylä, A. (2004). Reliability and validity in reseach based on naturally occuring social interaction. In D. Silverman (Ed.), *Qualitative research: theory, method and practice* (pp. 283-304). London: Sage.

Peräkylä, A. (2011). Validity in Research on Naturally Occuring Social Interaction. In D. Silverman (Ed.), *Qualitative research: theory, method and practice* (pp. 265-282). London: Sage.

Peteani, L. A. (2004). Enhancing clinical practice and education with high-fidelity human patient simulators. *Nurse Educator, 29*(1), 25-30.

Polit, D. F., & Beck, C. T. (2004). *Nursing research: principles and methods*. Philadelphia, Pa.: Lippincott Williams & Wilkins.

Polit, D. F., & Beck, C. T. (2010). *Essentials of nursing research: appraising evidence for nursing practice*. Philadelphia: Wolters Kluwer/Lippincott Williams & Wilkins.

QSEN. (2005). Quality and Safety Education for Nurses. from www.qsen.org (retrieved 7.11.11)

Rall, M., & Dieckmann, P. (2005). Safety culture and crisis resource management in airway management: general principles to enhance patient safety in critical airway situations. *Best Practice & Research. Clinical Anaesthesiology, 19*(4), 539-557.

Rall, M., & Gaba, D. M. (2005). Patient Simulators. In R. D. Miller (Ed.), *Miller's anesthesia* (pp. 3073-3103). Philadelphia: Elsevier.

Ramsden, P. (2003). *Learning to teach in higher education*. London: RoutledgeFalmer.

Rauen, C. A. (2004). Cardiovascular surgery. Simulation as a teaching strategy for nursing education and orientation in cardiac surgery. *Critical Care Nurse, 24*(3), 46-51.

Rhodes, M., & Curran, C. (2005). Use of the human patient simulator to teach clinical judgment skills in a baccalaureate nursing program. *CIN: Computers, Informatics, Nursing, 23*(5), 256-264.

Rystedt, H. (2002). *Bridging practices: simulations in education for the health-care professions. Doctoral dissertation.* Acta Universitatis Gothoburgensis, Göteborg.

Rystedt, H. (2009). Simulering- att återskapa vårdpraktiker som lärandemiljöer [Simulation-to recreate healthcare practices as learning environments]. In J. Linderoth (Ed.), *Individ, teknik och lärande [Individual, technology and learning]* (Vol. 1, pp. 44-66). Stockholm: Carlssons.

Rystedt, H., & Lindwall, O. (2004). The Interactive Construction of Learning Foci in Simulation-Based Learning Environments: A Case Study of an Anaesthesia Course. *PsychNology Journal, 2*(2), 168-188.

Rystedt, H., & Sjöblom, B. (2012). Realism, authenticity, and learning in healthcare simulations: rules of relevance and irrelevance as interactive achievements. *Instructional science, DOI 10.1007/s11251-012-9213-x*, 1-14.

Sacks, H., Schegloff, E. A., & Jefferson, G. (1974). A Simplest Systematics for the Organization of Turn-Taking for Conversation. *Language, 50*(4), 696-735.

Scherer, Y. K., Bruce, S. A., & Runkawatt, V. (2007). A comparison of clinical simulation and case study presentation on nurse practitioner students' knowledge and confidence in managing a cardiac event. *International Journal of Nursing Education Scholarship, 4*(1), 1-14.

Schön, D. A. (1983). *The reflective practitioner: how professionals think in action*. New York: Basic Books.

Seropian, M. A., Brown, K., Gavilanes, J. S., & Driggers, B. (2004). Simulation: not just a manikin. *Journal of Nursing Education, 43*(4), 164-169.

Silverman, D. (2006). *Interpreting qualitative data: methods for analyzing talk, text and interaction*. Los Angeles: SAGE.

Skiba, D. J. (2007). Nursing Education 2.0: Are Mashups Useful for Nursing Education? *Nursing Education Perspectives, 28*(5), 286-288.

Spunt, D., Foster, D., & Adams, K. (2004). Mock code: a clinical simulation module. *Nurse Educator, 29*(5), 192-194.

Stanley, M. J. C., & Dougherty, J. P. (2010). Nursing education model. A paradigm shift in nursing education: a new model. *Nursing Education Perspectives, 31*(6), 378-380.

Sutton, R. M., Niles, D., Meaney, P. A., Aplenc, R., French, B., Abella, B. S., et al. (2011). Low-Dose, High-Frequency CPR Training Improves

Skill Retention of In-Hospital Pediatric Providers. *Pediatrics, 128*(1), e145-e151.
Säljö, R. (2001). *Læring i praksis: et sosiokulturelt perspektiv [Learning in practice. a socio-cultural perspective]* Oslo: Cappelen akademisk.
Säljö, R. (2006). *Læring og kulturelle redskaper: om læreprosesser og den kollektive hukommelsen [Learning and cultural tools: about learning processes and collective memory]* Oslo: Cappelen akademisk forl.
Säljö, R. (2008). Lärande i människans landskap [Learning in the human landscape] In H. Rystedt & R. Säljö (Eds.), *Kunskap och människans redskap: teknik och lärande [Knowledge and human tools: technology and learning]* (pp. 13-27). [Lund]: Studentlitteratur.
Säljö, R., & Linderoth, J. (2002). *Utm@ningar och e-frestelser: IT och skolans lärkultur [Challenges and e-temptations: IT and the school's learning culture]* Stockholm: Prisma.
ten Have, P. (2004). Ethnomethodology. In C. Seale (Ed.), *Qualitative research practice* (pp. 151-164). London: Sage.
Vareide, P. K. (2001). *Stykkevis og helt: sykepleieres arbeidsoppgaver, kompetanse og yrkesidentitet i sykehus [By the piece and as a whole- nurses amount of work, competence and identity as nurses in hospitals]* (Vol. STF78 A013506). Trondheim: NIS helsetjenesteforskning.
Vygotskij, L. S., & Kozulin, A. (1986). *Thought and language*. Cambridge, Mass.: MIT Press.
Wadas, T. M. (1998). Role rehearsal: a mock code program. *Nursing Management, 29*(10), 48E.
Wellard, S. J., & Heggen, K. M. (2010). Are laboratories useful fiction? A comparison of Norwegian and Australian undergraduate nursing skills laboratories. *Nursing & Health Sciences, 12*(1), 39-44.
Wenger, E. (1998). *Communities of practice: learning, meaning, and identity*. Cambridge: Cambridge University Press.
Wertsch, J. V. (1998). *Mind as action*. New York: Oxford University Press.
Wertsch, J. V., Río, P. d., & Alvarez, A. (1995). *Sociocultural studies of mind*. Cambridge: Cambridge University Press.
WHO. (1984). *Health for All* Copenhagen: World Health Organisation.
Williams, R. M., Sundelin, G., Foster-Seargeant, E., & Norman, G. R. (2000). Assessing the reliability of grading reflective journal writing. *Journal of Physical Therapy Education, 14*(2), 23-26.
Xiao, Y., & Group, L. (2001). Understanding coordination in a dynamic medical environment: methods and results. In M. R. Endsley, M. McnNeese & E. Salas (Eds.), *New Trends in Cooperative Activities:*

Understanding System Dynamics in Complex Environments (pp. 242-258): Human Factors and Ergonomics Society, Santa Monica, CA.

Part II

List of papers

Paper I

Husebø, S.E., Friberg, F., Søreide, E. & Rystedt, H. (2011). Instructional problems in briefings: How to prepare nursing students for simulation-based cardiopulmonary resuscitation training. *Clinical Simulation in Nursing* doi:101016/jecns201012002 2011(0).

Paper II

Husebø, S.E., Rystedt, H. & Friberg, F. (2011). Educating for teamwork - nursing students' coordination in simulated cardiac arrest situations. *Journal of Advanced Nursing*, 67(10), 2239–2255.

Paper III

Husebø, S.E., Dieckmann, P., Rystedt, H., Søreide, E. & Friberg, F. (2010). Reflection on leadership in resuscitation teamwork in post-simulation debriefing in nursing education. Under review by *Simulation in Healthcare*.

Paper IV

Husebø, S.E., Bjørshol, C.A., Rystedt, H., Friberg, F. & Søreide, E. (2012). A comparative study of defibrillation and cardiopulmonary resuscitation performance during simulated cardiac arrest in nursing student teams. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, **20**:23, doi:10.1186/1757-7241-20-23. (published 02.04.12)

.

Papers 1, 2 and 3 are not available in UiS Brage due to copyright.

Eikeland Husebø et al. Scandinavian Journal of Trauma, Resuscitation and Emergency ?Medicine 2012, 20:23
http://www.sjtrem.com/content/20/1/23

SCANDINAVIAN JOURNAL OF
trauma, resuscitation & emergency medicine

ORIGINAL RESEARCH Open Access

A comparative study of defibrillation and cardiopulmonary resuscitation performance during simulated cardiac arrest in nursing student teams

Sissel I Eikeland Husebø[1*], Conrad A Bjørshol[2], Hans Rystedt[3], Febe Friberg[1,4] and Eldar Søreide[2]

Abstract

Background: Although nurses must be able to respond quickly and effectively to cardiac arrest, numerous studies have demonstrated poor performance. Simulation is a promising learning tool for resuscitation team training but there are few studies that examine simulation for training defibrillation and cardiopulmonary resuscitation (D-CPR) in teams from the nursing education perspective. The aim of this study was to investigate the extent to which nursing student teams follow the D-CPR-algorithm in a simulated cardiac arrest, and if observing a simulated cardiac arrest scenario and participating in the post simulation debriefing would improve team performance.

Methods: We studied video-recorded simulations of D-CPR performance in 28 nursing student teams. Besides describing the overall performance of D-CPR, we compared D-CPR performance in two groups. Group A (n = 14) performed D-CPR in a simulated cardiac arrest scenario, while Group B (n = 14) performed D-CPR after first observing performance of Group A and participating in the debriefing. We developed a D-CPR checklist to assess team performance.

Results: Overall there were large variations in how accurately the nursing student teams performed the specific parts of the D-CPR algorithm. While few teams performed opening the airways and examination of breathing correctly, all teams used a 30:2 compression: ventilation ratio.
We found no difference between Group A and Group B in D-CPR performance, either in regard to total points on the check list or to time variables.

Conclusion: We found that none of the nursing student teams achieved top scores on the D-CPR-checklist. Observing the training of other teams did not increase subsequent performance. We think all this indicates that more time must be assigned for repetitive practice and reflection. Moreover, the most important aspects of D-CPR, such as early defibrillation and hands-off time in relation to shock, must be highlighted in team-training of nursing students.

Keywords: Defibrillation, Cardiopulmonary resuscitation, Patient simulation, Nursing students

Introduction

Nurses and nursing students must be able to respond correctly in the event of a cardiac arrest both inside and outside hospitals [1-4]. Most nursing education institutions have resuscitation training within their curricula to meet these expectations and to ensure that students are competent at commencing life support in cases of cardiac arrest. In spite of this, previous studies in the nursing research literature have described poor retention of knowledge and skills in performing resuscitation [3,5-7]. Several educational methods of improving cardiopulmonary resuscitation (CPR) have been tried out but both content and methods lack standardization [3]. Nevertheless, simulation can be used to meet these

* Correspondence: sissel.i.husebo@uis.no
[1]Department of Health Studies, Faculty of Social Sciences, University of Stavanger, Stavanger 4036, Norway
Full list of author information is available at the end of the article

demands by creating learning opportunities that are unavailable in clinical practice, such as defibrillation and CPR (D-CPR) [8,9].

Several studies have been performed using cardiac arrest simulation to improve resuscitation performance by nurses [7,10-13]. However, there are few studies from the nursing education perspective that examine simulation for learning CPR. A previous study demonstrated that the nursing students needed several simulations to perform CPR accurately [14]. Scherer et al. [15] examined pre-and post-test knowledge of cardiac arrest and found no difference between the experimental group (simulation) and control group (case study seminar). Two other studies measuring satisfaction and/or self-confidence of nursing students after a cardiac arrest simulation demonstrated that students rated the experience as positive, enjoyable and instructive [16] and perceived the design and implementation to be very satisfying [17]. A study in medical practice demonstrated that observing simulation and participating in the post simulation debriefing in combination with participating in simulation improved performance in resuscitation [18]. A study of the briefing part of simulation in nursing education concluded that presupposing a higher level of resuscitation skills than expected in nursing education might interfere with opportunities to learn from simulation experiences [19]. Husebø et al. [20] identified three phases in resuscitation teamwork corresponding to the three first steps in the BLS algorithm: stating unconsciousness, preparing for resuscitation and initiating resuscitation, but questions remain unanswered as to which extent the nursing student teams followed the D-CPR algorithm and if different conditions in simulation improved team performance.

In this study, our aim was to investigate the extent to which nursing student teams followed the D-CPR algorithm. Moreover, we wanted to examine if observing one simulated cardiac arrest scenario and participation in one debriefing could improve team performance of D-CPR in a subsequent simulation.

Methods

Study participants

We invited half the cohort (n = 81) of nursing students from a three-year nursing education program at the University of Stavanger, Norway, to participate in the study. The students were in their last semester. Five faculty members participated as facilitators. The study was approved by the Norwegian Social Science Data Services (NSD) and the University of Stavanger but the ethics committee of the Western part of Norway declined to consider the application because the study did not involve patients or relatives. All students received oral and written information about the study at the start of the semester, and all participants signed an informed consent before being included in the study, confidentiality having been guaranteed. All 81 nursing students asked (72 female and 9 male) agreed to participate in the study; the average age was 26 (range 22-49 years). Each of the 28 nursing student teams consisted of between two and four team members. Eight of the teams included both males and females, while the rest consisted of females only.

Setting

The study took place in a simulation centre where the simulation environment resembled a room in an out-of-hospital rehabilitation unit. A full-size patient simulator (SimMan, Laerdal Medical Inc., Norway) was controlled by an operator in an adjacent room. The patient simulator was placed in a bed and exhibited clinical signs such as palpable pulses, breath movements and sounds. A speaker located in the mannequin's head transmitted the voice of the operator, thus giving the impression that the 'patient' could talk. The room was equipped with a training semi-automatic defibrillator (Heartstart FR2, Laerdal Medical Inc., Norway), oxygen, backboard, medications, an oro-pharyngeal airway and a bag-mask manual ventilator. The simulations were video-recorded by two separate video cameras.

Design and research procedures

The results are based on video-recordings of 28 simulated cardiac arrest scenarios in nursing education. The data were collected in February and March 2008. We first conducted a descriptive study of the overall D-CPR performance in 28 nursing student teams. Further, we compared performance of D-CPR in two groups of nursing student teams. Group A (14 teams) performed D-CPR in a simulated cardiac arrest scenario, while Group B (14 teams) performed D-CPR after first observing performance of Group A and participating in the debriefing.

Three weeks prior to the simulation, all students received the team schedule list, a short description of the scenario and the learning objectives. The learning objectives were: 1) using the D-CPR guidelines in practice, and 2) optimizing teamwork in resuscitation teams. The D-CPR course was developed for the last semester in nursing education and comprised a two-hour lecture in class about the semi-automatic defibrillator. All teams were given 45 min of individual practical training in CPR and use of a semi-automatic defibrillator [21,22] before participating in the team-based simulation of a cardiac arrest. For each simulation, teams in Group A participated in the simulation scenario while teams in Group B were present in the room to observe. After completion of the post-simulation debriefing, Group B performed the simulation scenario, while Group A observed (Figure 1).

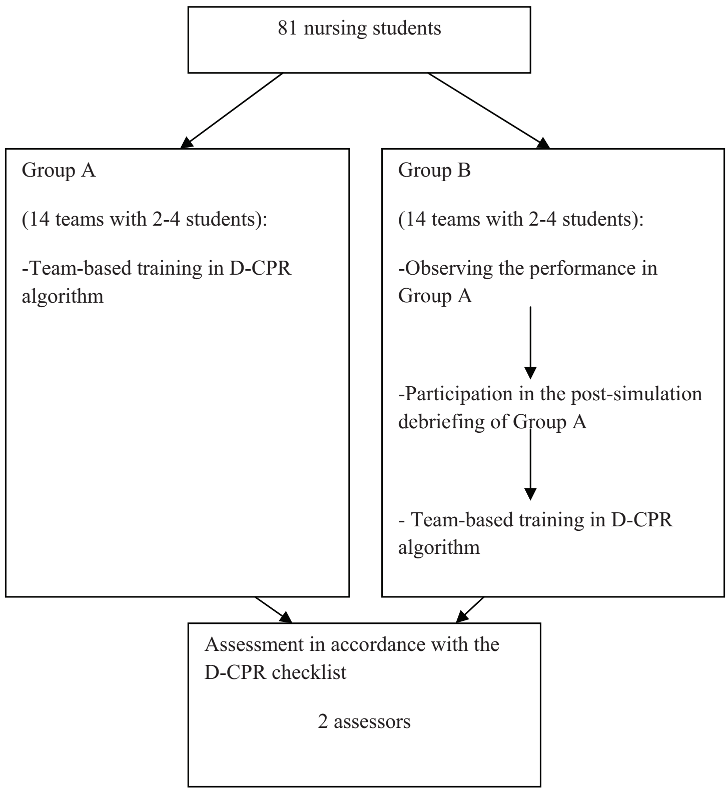


Figure 1 Outline of research design.

Prior to the simulation session, the facilitator gave all teams a 15-minute briefing regarding the function of the mannequin and the use of the medical equipment, and repeated the learning objectives. The following statement introduced the simulated scenario: The patient is a 71 year-old woman who has suffered an upper femur fracture and has been moved to an out-of-hospital rehabilitation unit without a physician present. The patient has a history of angina pectoris and is now complaining about chest pain. Your team are now required to manage this patient. The simulation started with the nurse entering the room to see if the patient had finished breakfast. After a few minutes with chest pain, the patient went into a cardiac arrest with a shock able rhythm. We discontinued the simulation 1 min after the first shock. Following the simulation, the students participated in the debriefing guided by the facilitator, who analysed team performance of D-CPR in relation to the learning objectives.

Assessment of team performance and development of the D-CPR checklist

We developed a 23-item check list (D-CPR checklist) with a total score range from 0 to 19 (items 1-19) and the actual number of seconds was used for three items (item 20, 21 and 24) to assess D-CPR team performance because no D-CPR checklist in Norwegian existed (Additional file 1). The D-CPR checklist was based on the Cardiff test protocol [23] and the checklist developed by Kromann et al. [22].

The Cardiff Test for basic life support (BLS) and the use of an automated external defibrillator (AED) from 2000 has been developed from previous editions and uses criterion-referenced assessments to evaluate CPR and AED performance from analysis of video recordings and data drawn from a computer attached to a training mannequin. The European Resuscitation Guidelines for CPR and AED were revised in 2005, and the D-CPR checklist in this study was revised accordingly [21]. The checklist developed by Kromann et al. [22] was based on the Advanced Life Support Cardiac Arrest Scenario Test checklist from 2005 [24]. For this study it was adjusted to assessment of basic life support and use of AED.

The researchers collaboratively designed the D-CPR checklist to match the curriculum of the course and expected team performance. For items 1 to 19, "yes" was coded as 1 and "no" as 0 (19 possible points). For items 20-24, *time from discovery of unconsciousness until chest compressions started*, *time from discovery of unconsciousness until shock was delivered* and *hands-off time in relation to first shock* the actual number of seconds was used. Firstly, two researchers independently assessed the performance of Group A and B in four of the cardiac arrest simulations. This served to refine the checklist, adjust items and calibrate judgments. Secondly, the two researchers independently assessed team performance for each item of the checklist in the remaining 24 scenarios. Thereafter, three errors of time registration were corrected, as these were caused by miscalculations. Seven differences in relation to timing of unconsciousness (item 20-21) were kept unchanged as these were caused by the difference between the two researchers in defining the exact point of time for discovering unconsciousness. Item 24 was calculated as the sum of items 22 and 23, and a summary of points for all teams according to each of the 19 items in the D-CPR-checklist was made. Further, the points given to each team by the two assessors were summarized separately and the mean values of the two sums were calculated.

Statistics

Paired samples *t*-test was used for analyses of variables with normal distribution, i.e. item 1 to 19, time from discovery of unconsciousness until chest compressions started (item 20) and time from discovery of unconsciousness until shock was delivered (item 21). The Wilcoxon signed rank test was used on item 24 (Hands-off time in relation to first shock) due to abnormal distribution. For parametric tests, the mean value with standard deviation (SD) was calculated. For non-parametric tests, the median values with interquartile range were calculated. All tests were two-sided and statistical significance was considered as $P < 0.05$. All analyses were performed with SPSS version 18 (Chicago, IL). Rater agreement, defined as the number of agreed assessments (x + y) divided by the number of agreed assessments + the number of disagreed assessments (z) [25], was calculated using the fraction: $\% = \frac{x + y}{(x + y) + z}$ (Additional file 2). However, this calculation has at least two weaknesses: it takes no account of where in the checklist the agreement was, and we would expect some agreement between the two raters by chance, even if they were guessing. We therefore calculated inter-rater reliability of the video assessment with kappa and linear weighting using VassarStats[a] (Additional file 2). It has been proposed that a kappa score of 0.81-1.00 indicates very good agreement, 0.41-0.80 moderate to good agreement, 0.21-0.40 fair agreement and below 0.20 poor agreement [26].

Reliability of the D-CPR checklist

Rater agreement for assessment of the D-CPR checklist was 0.88 $\left(88\% = \frac{318 + 149}{(318 + 149) + 65}\right)$ indicating a reliable checklist. Items regarding application of skills and medical devices received highest agreement between the two assessors (e.g. item 1. *Checked response verbally*, item 3. *Opened the airways*, item 5. *Verbally stated cardiac arrest*, and item 9. *Counted aloud*), whereas items regarding subjective data of D-CPR (e.g. item 2. *Checked response by shaking*, item 4. *Checked breathing for a max. 10 s.*, and item 18. *Said all away from the patient*) received lowest agreement (Additional file 2). The inter-rater reliability is shown in Additional file 2. There was very good or good strength agreement for nine items. However, there was fair strength of agreement on checking response by shaking, checking breathing and standing on their toes (Additional file 2). Differences between rater 1 and rater 2 in time variables (item 20, 21 and 24) demonstrated that one rater (rater 2) consistently assessed time intervals longer than the other (Additional file 3).

Results

Team performance of D-CPR

The nursing student teams achieved on average 59% of the D-CPR-checklist points $\left(x = \frac{\text{numbers of assessment with correct performance (n = 318)}}{\text{number of teams } (n = 28) \times \text{ numbers of items (n = 19)}} = 59\% = \frac{318}{532}\right)$ (Additional file 2). Twenty-five (89%) of 28 teams performed *checking response verbally*, while only 12 (43%) teams *checked response by shaking* as prescribed by the guidelines (Figure 2). *Opened the airways* was the most poorly performed part of the D-CPR. Only seven teams (25%) checked breathing for a maximum 10 s. The most correctly performed part of the D-CPR was the use of a 30:2 ratio in compressions and ventilation (Figure 2). All but one (96%) team applied the backboard while they performed chest compressions. Twenty-five (89%) teams attached pads correctly. All nursing student teams started chest compressions < 2 min. from discovery of unconsciousness. Twenty (72%) teams took < 3 min. from discovery of unconsciousness until shock was delivered and none of the

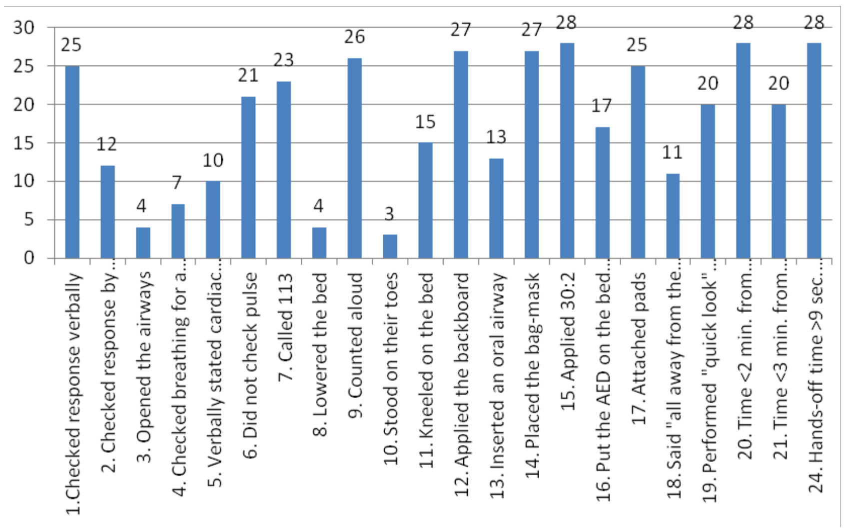


Figure 2 The number of nursing student teams (n = 28) that followed the D-CPR checklist. Teams for which there is disagreement in the assessed items are not included.

teams had < 9 s. hands-off time in relation to first shock (Figure 2).

Differences between group A and B in D-CPR performance

When comparing Group A and Group B there were no significant differences in performance of D-CPR either in total points (item 1-19) or time variables (item 20, 21 and 24) (Table 1). There was a small increase in total points of D-CPR performance for Group B, but the changes were not significant. When it comes to *time from discovery of unconsciousness until chest compressions started* Group B took on average 2 s more than Group A (item 20). Group B also took on average 4 s more than Group A from *discovery of unconsciousness until shock was delivered* (item 21). *Hands-off time in relation to first shock* was more or less the same for both groups (item 24).

Discussion

The results of our study indicate that most of the nursing student teams did not perform the D-CPR-checklist accurately. We could also demonstrate that observing one simulated cardiac arrest scenario and participating in one post simulation debriefing did not show a significant improvement in performance of D-CPR. These findings can at first sight appear as somewhat surprising since feedback in the debriefing has been identified as the most important feature of simulation-based education and a necessary condition for changing performance [27,28]. In the debriefings, the active students were encouraged to reflect on and analyse their own performance leading to meaningful learning [29], whilst the observing nursing student teams were asked to reflect on the performance of the active teams and to keep that in mind for their subsequent simulation. Consequently, it might have been too demanding for these teams to both apply the D-CPR algorithm and simultaneously apply the newly acquired insight from their observations in the subsequent scenario [20]. A second explanation for the results of our study is that it takes more than one simulation and repetitive practice with feedback to perform D-CPR with accuracy [5,14,30,31]. In the present study the nursing

Table 1 D-CPR Checklist points and measured time intervals for Group A and Group B assessed via video-recordings

Items	Group A (n = 14)	Group B (n = 14)	P
D-CPR performance (item 1-19)*	12 (11-14)	13 (11-15)	.566
Time (sec.) from discovery of unconsciousness until chest compressions started (item 20)	36 ± 16	38 ± 16	.744
Time (sec.) from discovery of unconsciousness until shock was delivered (item 21)	145 ± 61	149 ± 44	.808
Hands-off time (sec.) in relation to first shock (item 24)*	33 (28-40)	33 (28-44)	.675

Mean values ± standard deviation (* median values with interquartile range) student that were active in the second simulation had neither practiced themselves, nor got feedback on their performance before acting in the scenario.

In terms of D-CPR team performance, the findings are discouraging, in that procedures such as opening the airways and examination of breathing were not satisfactory. However, this does not mean that the nursing student teams failed to develop any of the D-CPR skills. The findings clearly demonstrated that the student teams achieved almost two-thirds (59%) of the D-CPR-checklist points by participating in a simulated cardiac arrest scenario. These findings are in line with the results of a study that compared a traditional, small-group D-CPR course with an Internet-based D-CPR course teaching basic life support [32]. Mäkinen et al. found that nurses receiving the traditional, small-group D-CPR course performed better than those receiving the Internet-based D-CPR course [32]. The importance of leadership in team performance has been demonstrated in previous research [33,34], but assessing leadership was beyond the scope and intent of this article.

The mean time from discovery of unconsciousness until chest compressions started was 36.3 s in Group A and 38 s in Group B. All teams took < 2 min. until chest compressions were initiated. Previous research has shown that the interval between discovery of unconsciousness until chest compressions start affects survival in cardiac arrest [35]. Holmberg et al. found that there was significantly increased survival at one month for patients who received CPR ≤ 2 min after collapse compared to patients who received CPR > 2 min. after collapse [35]. Our results indicate that all nursing student teams understood the importance of acting rapidly and starting chest compressions early to increase survival after cardiac arrest. If the teams had further trained in recognizing a cardiac arrest by stating unconsciousness and confirming abnormal breathing, the time to first chest compression could possibly have been further reduced.

Time from discovery of unconsciousness until shock is delivered influences survival in in-hospital cardiac arrest [36]. Herlitz et al. demonstrated that the overall survival rates were 72% for patients defibrillated within 3 min. after collapse on non-monitored wards [36]. In our study we found that, on average, all teams delivered first shock within the first three minutes, but the variance within the teams was large. This means that 8 teams took > 3 min. from discovery of unconsciousness until shock was delivered. These findings may be explained by confusion as to whether to deliver immediate defibrillation in case of witnessed cardiac arrest was appropriate or whether to execute 3 min. of CPR before defibrillation in case of non-witnessed cardiac arrest (Norwegian Resuscitation Council). This observation calls for a clear explanation of the correct algorithm to follow and more attention to early defibrillation in simulation-based D-CPR courses in nursing education; it should be specifically highlighted in the debriefing.

The results demonstrated that all teams spent too long hands-off time in relation to first shock. Hands-off time in relation to first shock is associated with decrease in survival [37]. A recent study aiming to define the optimal pre- and post-defibrillation compression pauses for out-of-hospital cardiac arrest revealed that hands-off time > 9 s. in relation to first shock decreased the return of spontaneous circulation [38]. The long time intervals concerning hands-off time in relation to first shock have educational implications.

In summary, this study has demonstrated that observing one simulation performed by another team and participating in its debriefing does not improve nursing student performance in a subsequent simulated cardiac arrest scenario. Further, this study has demonstrated that the five-hour program in D-CPR is insufficient for learning to perform D-CPR correctly. There is reason to believe that the program should include repetitive practice, feedback and testing of D-CPR performance, as previously demonstrated by Oermann et al. and Sutton et al. [30,31].

The major limitations of this study were its small sample size as well as its limitation of having been carried out in one nursing education institution, in one geographical location in Norway. Ideally, the design of the educational study should include a pre-test. However, in this study, a pre-test to examine if different conditions would change the team performance of D-CPR could possibly have influenced the performance of teams in Group A. To strengthen reliability, mannequin-based data of CPR performance should be used in addition to observational data [39]. The video observations in this study demonstrate that the raters assessed some aspects of D-CPR performance in different ways, indicated by some large inter-observer differences. The use of medical devices (e.g. bag-mask, oro-pharyngeal airway and backboard) is easy to assess, whereas aspects of D-CPR such as "checked response by shaking" and "checked breathing for a max. 10 s." depends on the individual investigators' judgment and interpretation. The difference in two time variables (item 20 and 21) between the two raters probably means that defining the exact point of time for discovering unconsciousness is different. These results are contrary to the findings in a study that assessed Advanced Life Support competence and found good reliability of the scores [40]. One reasonable explanation of the variations in inter-rater agreement in this study is that the two raters did not make a consensus scoring after the first individual assessment as in Ringsted et al. [40].

Conclusion

This study revealed that observing training of other teams and participating in the debriefing did not itself improve performance of D-CPR in nursing student teams. The findings call for more time for repetitive practice and reflection and highlight that the most important aspects of D-CPR, like early defibrillation and hands-off time in relation to shock, must be emphasised during team training of nursing students.

Endnote

[a]http://faculty.vassar.edu/lowry/VassarStats.html accessed in January 2012.

Additional material

Additional file 1: The D-CPR checklist.

Additional file 2: The number of nursing student teams (n = 28) that followed the D-CPR checklist, number of items with agreement and disagreement between the two raters, mean (*median) values of time variables and kappa with linear weighting.

Additional file 3: Differences between rater 1 and rater 2 in time variables, item 20 Time (sec.) from discovery of unconsciousness until chest compressions started, 21 Time (sec.) from discovery of unconsciousness until shock was delivered and 24 Hands-off time (sec.) in relation to first shock.

Author details

[1]Department of Health Studies, Faculty of Social Sciences, University of Stavanger, Stavanger 4036, Norway. [2]Department of Anaesthesiology and Intensive Care, Stavanger University Hospital, PO Box 8100, Stavanger 4068, Norway. [3]Department of Education, Communication and Learning, University of Gothenburg, Läroverksgatan 15, PO Box 300, Gothenburg SE 405 30, Sweden. [4]Institute of Health and Care Sciences, Sahlgrenska Academy at University of Gothenburg, PO Box 100, Gothenburg S-405 30, Sweden.

Authors' contributions

SEH participated in the design and planning of the study and the development of the D-CPR checklist; collected the data, assessed the video recordings, performed the descriptive statistics, wrote the manuscript draft, and coordinated the subsequent versions of the manuscript. CAB participated in the development of the D-CPR checklist, assessed the video recordings, performed the statistical analysis, and made important additions in drafting the manuscript. HR and FF participated in the design and planning of the study, revised the study manuscript and made important additions. ES participated in the design and planning of the study and was involved in drafting and revising the manuscript. All authors have reviewed the submitted version. All authors read and approved the final manuscript.

Competing interests

SEH is employed part-time (25%) as Training Coordinator of University Programs at Stavanger Acute Medicine Foundation for Education and Research (SAFER). CAB is employed part-time (20%) as a facilitator at SAFER. ES is medical director at SAFER. SEH has received financial support from the Laerdal Foundation for Acute Medicine but otherwise the authors declare they have no competing interests and no financial disclosures.

Received: 19 November 2011 Accepted: 2 April 2012
Published: 2 April 2012

References

1. Bruce SA, Scherer YK, Curran CC, Urschel DM, Erdley S, Ball LS: **A COLLABORATIVE EXERCISE: Between Graduate and Undergraduate Nursing Students Using a COMPUTER-ASSISTED SIMULATOR in a Mock Cardiac Arrest.** *Nurs Educ Perspect* 2009, **30(1)**:22-27.
2. Davies N, Gould D: **Updating cardiopulmonary resuscitation skills: a study to examine the efficacy of self-instruction on nurses' competence.** *J Clin Nurs* 2000, **9(3)**:400-410.
3. Hamilton R: **Nurses' knowledge and skill retention following cardiopulmonary resuscitation training: a review of the literature.** *J Adv Nurs* 2005, **51(3)**:288-297.
4. Preusch MR, Bea F, Roggenbach J, Katus HA, Junger J, Nikendei C: **Resuscitation Guidelines 2005: does experienced nursing staff need training and how effective is it?** *Am J Emerg Med* 2010, **28(4)**:477-484.
5. Madden C: **Undergraduate nursing students' acquisition and retention of CPR knowledge and skills.** *Nurse Educ Today* 2006, **26(3)**:218-227.
6. Badger T, Rawstorne D: **An evaluative study of pre-registration nursing students' skills in basic life support.** *Nurse Educ Today* 1998, **18(3)**:231-236.
7. Hammond F, Saba M, Simes T, Cross R: **Advanced Life Support: retention of registered nurses' knowledge 18 months after initial training.** *Aust Crit Care* 2000, **13(3)**:99-104.
8. Liaw SY, Rethans J-J, Scherpbier A, Piyanee K-Y: **Rescuing A Patient In Deteriorating Situations (RAPIDS): a simulation-based educational program on recognizing, responding and reporting of physiological signs of deterioration.** *Resuscitation* 2011, **82(9)**:1224-1230.
9. Lupien AE, George-Gay B: **High-fidelity Patient Simulation.** In *Fuszard's innovative teaching strategies in nursing.* Edited by: Lowenstein AJ, Bradshaw MJ. Gaithersburg: Aspen Publishers; 2010:378 s.
10. Flisher D: **Improving nurses' resuscitation skills.** *Nurs Stand* 1992, **6(50)**:32-35.
11. Rivera TM, Gabriel S: **How effectively do you function in a cardiac arrest? A creative program approach to code skills.** *J Contin Educ Nurs* 1995, **26(5)**:226-229.
12. Granneman SBSNRN, Conn VSPRN: **An Evaluation of the Effectiveness of Competency-Based Code Blue Education.** *Journal of Nursing Staff Development November/December* 1996, **12(6)**:283-288.
13. Wadas TM: **Role rehearsal: a mock code program.** *Nurs Manage* 1998, **29(10)**:48E.
14. Linnard-Palmer L: **The effect of a skills algorithm on nursing students' response rate, skill accuracy, and reported attention management during simulated cardiopulmonary arrests.** San Francisco: University of San Francisco; 1996.
15. Scherer YK, Bruce SA, Runkawatt V: **A comparison of clinical simulation and case study presentation on nurse practitioner students' knowledge and confidence in managing a cardiac event.** *Int J Nurs Educ Scholarsh* 2007, **4(1)**:1-14.
16. Childs JC, Sepples S: **Clinical teaching by simulation: lessons learned from a complex patient care scenario.** *Nurs Educ Perspect* 2006, **27(3)**:154-158.
17. Kardong-Edgren SE, Starkweather AR, Ward LD: **The integration of simulation into a clinical foundations of nursing course: student and faculty perspectives.** *Int J Nurs Educ Scholarsh* 2008, **5(1)**:1-16.
18. Pascual JL, Holena DN, Vella MA, Palmieri J, Sicoutris C, Selvan B, Fox AD, Sarani B, Sims C, Williams NN, *et al*: **Short simulation training improves objective skills in established advanced practitioners managing emergencies on the ward and surgical intensive care unit.** *J Trauma* 2011, **71(2)**:330-338.
19. Husebø SE, Friberg F, Søreide E, Rystedt H: **Instructional Problems in Briefings: How to Prepare Nursing Students for Simulation-Based Cardiopulmonary Resuscitation Training.** *Clinical Simulation in Nursing* , doi:101016/jecns201012002 2011(0).
20. Husebø SE, Rystedt H, Friberg F: **Educating for teamwork - nursing students' coordination in simulated cardiac arrest situations.** *J Adv Nurs* 2011, **67(10)**:2239-2255.
21. Handley AJ, Koster R, Monsieurs K, Perkins GD, Davies S, Bossaert L: **European Resuscitation Council Guidelines for Resuscitation 2005: Section 2. Adult basic life support and use of automated external defibrillators.** *Resuscitation* 2005, **67(Supplement 1(0))**:S7-S23.
22. Kromann CB, Jensen ML, Ringsted C: **The effect of testing on skills learning.** *Medical Education* 2009, **43(1)**:21-27.

23. Whitfield RH, Newcombe RG, Woollard M: **Reliability of the Cardiff Test of basic life support and automated external defibrillation version 3.1.** *Resuscitation* 2003, **59(3)**:291-314.
24. Nolan JP, Deakin CD, Soar J, Böttiger BW, Smith G: **European Resuscitation Council Guidelines for Resuscitation 2005: Section 4. Adult advanced life support.** *Resuscitation* 2005, **67(Supplement 1)**:S39-S86.
25. Dyrholm Siemensen IM: **Et eksplorativet studie av faktorer der påvirker sikkerheten af patient-overgange (An explorative study of factors influencing safety in patient handovers).** Lyngby: Danmarks Tekniske Universitet; 2011.
26. Fleiss JL, Levin B, Paik MC: **The Measurement of Interrater Agreement.** In *Statistical Methods for Rates and Proportions.* Edited by: Fleiss JL, Levin B, Paik MC. Hoboken, NJ: John Wiley 2004:598-626.
27. Issenberg SB, McGaghie WC, Petrusa ER, Gordon DL, Scalese RJ: **Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review.** *Medical Teacher* 2005, **27(1)**:10-28.
28. Seropian MA, Brown K, Gavilanes JS, Driggers B: **Simulation: not just a manikin.** *J Nurs Educ* 2004, **43(4)**:164-169.
29. Dreifuerst KT: **The essentials of debriefing in simulation learning: a concept analysis.** *Nurs Educ Perspect* 2009, **30(2)**:109-114.
30. Oermann MH, Kardong-Edgren SE, Odom-Maryon T: **Effects of monthly practice on nursing students' CPR psychomotor skill performance.** *Resuscitation* 2011, **82(4)**:447-453.
31. Sutton RM, Niles D, Meaney PA, Aplenc R, French B, Abella BS, Lengetti EL, Berg RA, Helfaer MA, Nadkarni V: **Low-Dose, High-Frequency CPR Training Improves Skill Retention of In-Hospital Pediatric Providers.** *Pediatrics* 2011, **128(1)**:e145-e151.
32. Mäkinen M, Castrèn M, Tolska T, Nurmi J, Niemi-Murola L: **Teaching basic life support to nurses.** *European Journal Of Anaesthesiology* 2006, **23(4)**:327-331.
33. Siassakos D, Fox R, Crofts JF, Hunt LP, Winter C, Draycott TJ: **The management of a simulated emergency: Better teamwork, better performance.** *Resuscitation* 2011, **82(2)**:203-206.
34. Hunziker S, Bühlmann C, Tschan F, Balestra G, Legeret C, Schumacher C, Semmer NK, Hunziker P, Marsch S: **Brief leadership instructions improve cardiopulmonary resuscitation in a high-fidelity simulation: A randomized controlled trial.** *Crit Care Med* 2010, **38(4)**:1086-1091.
35. Holmberg M, Holmberg S, Herlitz for the Swedish Cardiac Arrest Registry J: **Factors modifying the effect of bystander cardiopulmonary resuscitation on survival in out-of-hospital cardiac arrest patients in Sweden.** *Eur Heart J* 2001, **22(6)**:511-519.
36. Herlitz J, Aune S, Bång A, Fredriksson M, Thorén A-B, Ekström L, Holmberg S: **Very high survival among patients defibrillated at an early stage after in-hospital ventricular fibrillation on wards with and without monitoring facilities.** *Resuscitation* 2005, **66(2)**:159-166.
37. Cheskes S, Schmicker RH, Christenson J, Salcido DD, Rea T, Powell J, Edelson DP, Sell R, May S, Menegazzi JJ, *et al*: **Perishock Pause/Clinical Perspective.** *Circulation* 2011, **124(1)**:58-66.
38. Sell RE, Sarno R, Lawrence B, Castillo EM, Fisher R, Brainard C, Dunford JV, Davis DP: **Minimizing pre- and post-defibrillation pauses increases the likelihood of return of spontaneous circulation (ROSC).** *Resuscitation* 2010, **81(7)**:822-825.
39. Lynch B, Einspruch EL, Nichol G, Aufderheide TP: **Assessment of BLS skills: Optimizing use of instructor and manikin measures.** *Resuscitation* 2008, **76(2)**:233-243.
40. Ringsted C, Lippert F, Hesselfeldt R, Rasmussen MB, Mogensen SS, Frost T, Jensen ML, Jensen MK, Van der Vleuten C: **Assessment of Advanced Life Support competence when combining different test methods-Reliability and validity.** *Resuscitation* 2007, **75(1)**:153-160.

doi:10.1186/1757-7241-20-23
Cite this article as: Eikeland Husebø *et al.*: A comparative study of defibrillation and cardiopulmonary resuscitation performance during simulated cardiac arrest in nursing student teams. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine* 2012 **20**:23.

Additional files provided with this submission:

Additional file 1: Appendix 1.docx, 12K
http://www.sjtrem.com/imedia/5628515276377787/supp1.docx
Additional file 2: Appendix 2.doc, 64K
http://www.sjtrem.com/imedia/4225044276677482/supp2.doc
Additional file 3: Appendix 3.doc, 173K
http://www.sjtrem.com/imedia/1610887533667748/supp3.doc

Appendix 1

The D-CPR checklist

No	**Items**	
1	Checked response verbally	Yes/No
2	Checked response by shaking	Yes/No
	Examination	
3	Opened the airways	Yes/No
4.	Checked breathing for a max. 10 sec.	Yes/No
5	Verbally stated cardiac arrest	Yes/No
6	Did not check pulse	Yes/No
7	Called 113	Yes/No
	Performance of chest compressions	
8	Lowered the bed	Yes/No
9	Counted aloud	Yes/No
10	Stood on their toes	Yes/No
11	Kneeled on the bed	Yes/No
12	Applied the backboard	Yes/No
	Performance of ventilations	
13	Inserted an oro-pharyngeal airway	Yes/No
14	Placed the bag-mask	Yes/No
15	Applied 30:2	Yes/No
	Use of semi-automatic defibrillator	
16	Put the semi-automatic defibrillator on the bed table	Yes/No
17	Attached pads	Yes/No
18	Said "all away from the bed/patient"	Yes/No
19	Performed "quick look" (that everybody was away)	Yes/No
	Time items	
20	Time from discovery of unconsciousness until chest compressions started	Time (seconds)
21	Time from discovery of unconsciousness until shock was delivered	Time (seconds)
22	Hands-off time from delivery of first shock until first compression was performed	Time (seconds)
23	Hands-off time from last compression until delivery of shock	Time (seconds)
24	Hands-off time in relation to first shock	Time (seconds)

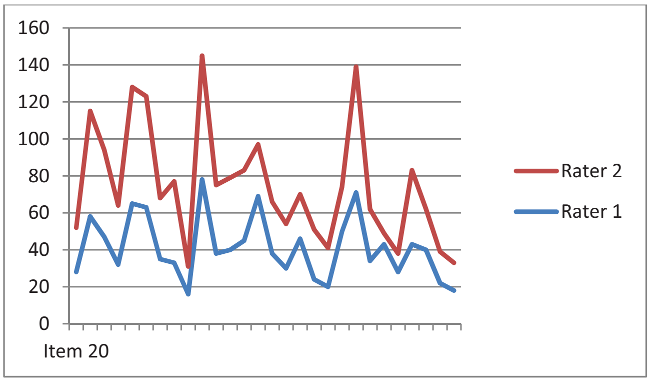
Appendix 2.
The number of nursing student teams (n=28) that followed the D-CPR checklist, number of items with agreement and disagreement between the two raters, mean (*median) values of time variables and kappa with linear weighting.

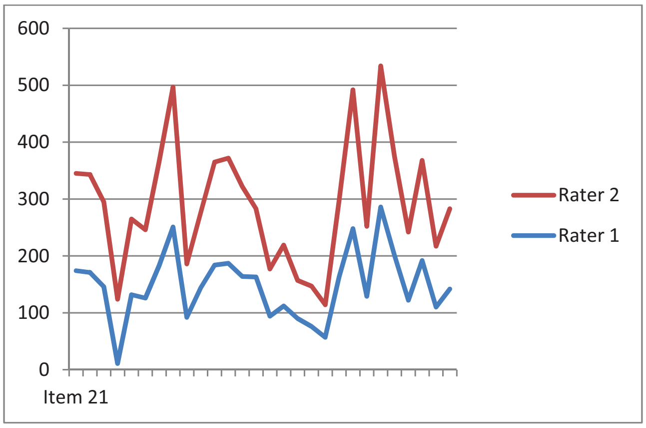
No.	Items	Yes	No	Agree-ment	Disagree-ment	Time (seconds)	*K*
1	Checked response verbally	25 (89%)	3(11%)	28(100%)	0		1.00
2	Checked response by shaking	12 (43%)	7(25%)	19(68%)	9(32%)		0.38
3	Opened the airways	4 (14%)	21(75%)	25(89%)	3(11%)		0.67
4	Checked breathing for a max. 10 sec.	7 (25%)	10 (36%)	17(61%)	11 (39%)		0.28
5	Verbally stated cardiac arrest	10 (36%)	17 (61%)	27(53%)	1(3.5%)		0.92
6	Did not check pulse	21 (75%)	4 (14%)	25(89%)	3(11%)		0.66
7	Called 113	23 (82%)	0	23(82%)	5(18%)		n.c.
8	Lowered the bed	4 (14%)	21(75%)	25(89%)	3(11%)		0.66
9	Counted aloud	26 (93%)	1 (3.5%)	27(96.5%)	1(3.5 %)		0.65
10	Stood on their toes	3 (11%)	15 (53%)	18(64%)	10 (36%)		0.24
11	Kneeled on the bed	15 (53%)	11 (39%)	26(92%)	2(8%)		0.85
12	Applied the backboard	27(96.5%)	0	27(96.5%)	1(3.5%)		0.00
13	Inserted an oro-pharyngeal airway	13 (46%)	14 (50%)	27(96%)	1 (4%)		0.93
14	Placed the bag-mask	27(96.5%)	0	27(96%)	1(3.5%)		0.00
15	Applied 30:2	28 (100%)	0	28(100%)	0		n.c.
16	Put the semi-automatic defibrillator on the bed table	17 (61%)	11(39%)	28(100%)	0		1.00
17	Attached pads	25 (89%)	0	25(89%)	3 (11%)		n.c.
18	Said "all away from the bed/patient"	11 (39%)	10 (36%)	21(75%)	7 (25%)		0.51
19	Performed "quick look" (that everybody was away)	20 (72%)	4 (14%)	24(86%)	4 (14%)		0.58
	Total numbers of assessment	318 (59 %)	149 (28.0%)	467 (88%)	65 (13%)		
	Time items						
20	Time from discovery of unconsciousness until chest compressions started					37	
21	Time from discovery of unconsciousness until shock was delivered					147	
24	Hands-off time in relation to first shock					*33	

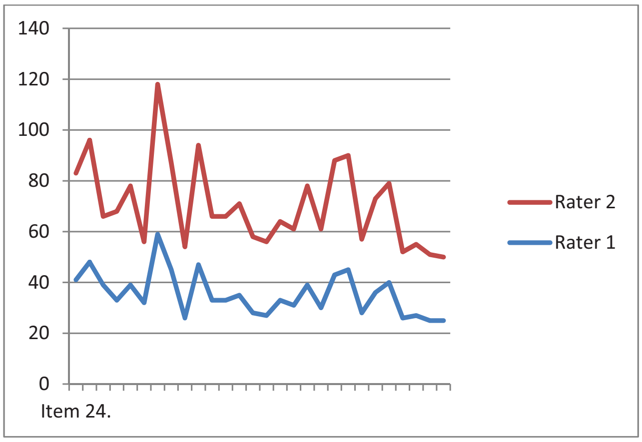
n.c.= not calculated. This quantity cannot be calculated

Appendix 3.

Differences between rater 1 and rater 2 in time variables, item 20 *Time (sec.) from discovery of unconsciousness until chest compressions started*, 21 *Time (sec.) from discovery of unconsciousness until shock was delivered* and 24 *Hands-off time (sec.) in relation to first shock*







Appendix 1

Information to the participants and consent form (in Norwegian)

Studenteksemplar

Forespørsel om deltagelse i studien: Sykepleierstudentenes læring i møte med teknologien - simulering som pedagogisk metode i sykepleierutdanningen

Jeg holder på med en studie om hva sykepleierstudentene lærer ved simulering av en akuttsituasjon. Hensikten med studien er å få kjennskap til om studentene i simulering lærer noe om sykepleie og behandling ved hjerteinfarkt, hjertestans og bruk av hjertestarter, og det studentene selv løfter fram som enkelt og vanskelig ved simulering. Mitt spørsmål til deg er om du vil være med i studien. Simuleringen vil være identisk med den som alle 3.årsstudenter gjennomfører mens de er i praksis. Hele simuleringen og den etterfølgende gjennomgangen (debriefingen) vil bli videofilmet ved hjelp av kamera som er montert på simuleringsrommet.

Mitt fokus kommer ikke til å være om det du gjør eller sier under simuleringen er rett eller feil. Simuleringen og etterfølgende gjennomgang vil til sammen ta ca. 2 timer. Min egen rolle under simuleringene vil være som observatør for bedre å kunne forstå hva som hender, og for å sikre at alt det tekniske innspillingsutstyret fungerer. Videoopptakene og lydbåndopptakene blir behandlet konfidensielt og anonymisert. Det er intet pålegg fra ledelsen, lærere eller veiledere ved skolen om deltakelse i studien. Jeg håper at kunnskapen som fremkommer vil bidra til en videreutvikling av pedagogiske metoder i sykepleie- og helsefagutdanninger, og at studentenes egne oppfatninger av simulering som undervisningsmetode vil bli mer kjent.

Videoopptakene og lydfilene fra lydbåndopptakene vil lagres på min datamaskin som er sikret med brukernavn og passord, og lydbåndopptaker vil bli oppbevart i låsbart skap på Universitetet. Ingen skriftlig eller muntlig fremstilling av hva som sies og gjøres på opptakene vil kunne tilbakeføres til deg som enkelt person. Opptakene vil bli slettet etter at prosjektet er avsluttet.

Jeg håper at du ønsker å delta i denne studien, i så fall vil du sammen med dine medstudenter som også har gitt sitt samtykke til å delta bli inndelt i grupper á 6 studenter. Informasjon om dato og klokkeslett for simulering ved SAFER vil legges ut på "It's learning" i god tid før oppmøte. Deltakelsen i studien medfører ingen kostnader og du får ingen betaling for å delta.

Deltakelse i studien er helt frivillig. Selv om du sier ja til å delta i dag, kan du trekke deg fra studien når du måtte ønske det og uten at det vil ha konsekvenser for din nåværende eller fremtidige studiesituasjon ved instituttet. I så fall ta kontakt med kullkoordinator Anne Margrethe Aasland, tlf. 51834193. Det er ingen risiko forbundet med denne studien.

Om du har spørsmål om deltakelse eller om selve studien, kan du ringe til meg når du måtte ønske på telefon 958 97 983 eller ta kontakt via e-post (sissel.i.husebo@uis.no), eller til min hovedveileder Febe Friberg, telefon 51 83 41 92.

Dersom du er villig til å delta, vennligst skriv under på "Samtykkeerklæringen" på neste side, og lever den i ekspedisjonen ved Institutt for helsefag innen *ddmmår*.

Sissel Eikeland Husebø	Febe Friberg
Dr.gr.student	førsteamanuensis
Institutt for helsefag	Institutt for helsefag
Universitetet i Stavanger	Universitetet i Stavanger

Sykepleierstudentenes læring i møte med teknologien - simulering som pedagogisk metode i sykepleierutdanningen

Samtykkeerklæring

Jeg har mottatt skriftlig og muntlig informasjon om studien og sier meg villig til å delta.

____________________ ________________________

Sted/ dato Studentens navn

Lærereksemplar

Forespørsel om deltagelse i studien: Sykepleierstudentenes læring i møte med teknologien - simulering som pedagogisk metode i sykepleierutdanningen

Jeg holder på med en studie om hva sykepleierstudentene lærer ved simulering av en akuttsituasjon. Hensikten med studien er å få kjennskap til om studentene i simulering lærer noe om sykepleie og behandling ved hjerteinfarkt, hjertestans og bruk av hjertestarter, og det studentene selv løfter fram som enkelt og vanskelig ved simulering. Mitt spørsmål til deg er om du vil være med i studien. Simuleringen vil være identisk med den som alle 3.årsstudenter gjennomfører mens de er i praksis, og du som lærer skal gjøre som du pleier å gjøre. Hele simuleringen og den etterfølgende gjennomgangen (debrifingen) vil bli videofilmet ved hjelp av kamera som er montert på simuleringsrommet.

Mitt fokus kommer ikke til å være om det du gjør eller sier under simulering og debrifing er rett eller feil. Simuleringen og etterfølgende gjennomgang vil til sammen ta ca. 2 timer. Min egen rolle under simuleringene vil være som observatør for bedre å kunne forstå hva som hender, og for å sikre at alt det tekniske innspillingsutstyret fungerer. Videoopptakene og lydbåndopptakene blir behandlet konfidensielt og anonymisert. Det er intet pålegg fra ledelsen ved skolen om deltakelse i studien. Jeg håper at kunnskapen som fremkommer vil bidra til en videreutvikling av pedagogiske metoder i sykepleie- og helsefagutdanninger, og at studentenes egne oppfatninger av simulering som undervisningsmetode vil bli mer kjent.

Videoopptakene og lydfilene fra lydbåndopptakene vil lagres på min datamaskin som er sikret med brukernavn og passord, og lydbåndopptaker vil bli oppbevart i låsbart skap på Universitetet. Ingen skriftlig eller muntlig fremstilling av hva som sies og gjøres på opptakene vil kunne tilbakeføres til deg som enkelt person. Opptakene vil bli slettet etter at prosjektet er avsluttet.

Videoopptakene vil fortrinnsvis foregå i uke 7-10, 2008. Informasjon om dato og klokkeslett for simulering ved SAFER vil du få per mail i god tid på forhånd. Deltakelsen i studien medfører ingen kostnader og du får ingen betaling for å delta.

Deltakelse i studien er helt frivillig. Selv om du sier ja til å delta i dag, kan du trekke deg fra studien når du måtte ønske det og uten at det vil ha konsekvenser for din nåværende eller fremtidige arbeidssituasjon ved instituttet. Det er ingen risiko forbundet med denne studien.

Om du har spørsmål om deltakelse eller om selve studien, kan du ringe til meg når du måtte ønske på telefon 958 97 983 eller ta kontakt via e-post (sissel.i.husebo@uis.no), eller til min hovedveileder Febe Friberg, telefon 51 83 41 92.

Dersom du er villig til å delta, vennligst skriv under på ”Samtykkeerklæringen” på neste side, og legg den i min posthylle i ekspedisjonen ved Institutt for helsefag innen 17.01.08.

Sissel Eikeland Husebø

Dr.gr.student

Institutt for helsefag
Universitetet i Stavanger

Febe Friberg

førsteamanuensis

Institutt for helsefag
Universitetet i Stavanger

Sykepleierstudentenes læring i møte med teknologien - simulering som pedagogisk metode i sykepleierutdanningen

Samtykkeerklæring

Jeg har mottatt skriftlig og muntlig informasjon om studien og sier meg villig til å delta.

____________________ ________________________

Sted/ dato Navn

Appendix 2

A cardiac arrest scenario

A cardiac arrest scenario

Cardiac arrest in an out-of-hospital rehabilitation unit

Course of case history:

Brenda Nilsen, aged 71, has suffered an upper femur fracture and had been moved to an out-of-hospital rehabilitation unit.

The recovery has until now proceeded without complications, and her training shows good progress. A year ago she was admitted to the medical ward for a small infarct. She has suffered from Angina Pectoris for around 11 years, for which she takes Nitromex. She is hard of hearing.

You are a nurse in the ward and are going in to collect Mrs. Nilsen's breakfast tray. She is complaining about short-windedness, and says she has a pain in her jaw. After a while Mrs. Nilsen goes into a cardiac arrest.

Facilitator manual

Allow the students to familiarize themselves with SimMan:

- Listen to the patient simulator – heart and lungs
- Demonstrate pulse and blood pressure gauging
- Demonstrate how to feel the pulse, tell students that the pulse disappears in different places if blood pressure is low
- Inform them about papilla and skin – students must ask facilitator for these observations
- Inform them that one must ventilate and use a bag on SimMan

Familiarize students with the room (patient room in Rehab ward):

Access to oxygen sources on the wall, oropharyngeal airway, bag- mask, medication, emergency suitcase, heart tray and a semi-automatically defibrillator available in the corridor.

Learning objectives:

1) Optimizing leadership in resuscitation teams

2) Putting the D-CPR algorithm into practice

Information given to the students
Course of case history: Brenda Nilsen, aged 71, has suffered an upper femur fracture and had been moved to an out-of-hospital rehabilitation unit without a staff physician present. The recovery has until now proceeded without complications, and her training shows good progress. A year ago she was admitted to the medical ward for a small infarct. She has suffered from Angina Pectoris for around 11 years, for which she takes Nitromex. She is hard of hearing. The scenario starts when you (the nurse) are going in to collect up Mrs. Nilsen's breakfast tray. She is complaining about short-windedness and says she has pains in her jaw. After a while Mrs. Nilsen has a cardiac arrest. Blood Pressure: 160/90 and pulse: 110 Skin clammy with cold sweat Additional information: Extra help may be had by going into the corridor and fetching two nurses Chief physician/Deputy superintendent and the emergency service can be contacted by telephone

Students get one minute to organize/define the roles themselves, which comprise one as the team leader and the other two as nurses waiting in the corridor until they are summoned.

Output values:

A –Has free respiratory passage, but is short-winded

B –Respiration frequency 22

C – BT 160/90 and P: 110

Skin clammy with cold sweat

Anticipated course:

Nitromex does not rid the patient of her pain. She is also complaining about nausea and throws up her breakfast. Mrs. Nilsen says she feels palpitations and that she is about to faint. Suddenly the patient gasps and becomes unconscious. It is impossible to get in touch with her. She goes into respiratory arrest and cardiac arrest (ventricular flutter).

Proposal for correct treatment:

- Get more help (2 nurses)
- Observe and assess vital signs according to A-B-C principles
- Contact chief physician/deputy superintendent who prescribes 4l Oxygen on nose catheter,
- Nitromex resoriblett 0.5 mg sublingual, Afipran 10 mg iv. and Morphine 5mg iv.
- Administer medication according to doctors' order
- Therapeutic communication and sufficient information to calm the patient, who is anxious
- Ensure unobstructed respiratory passage; be aware of vomit, by means of jaw grip/oropharyngeal airway. Contact emergency service by telephone and start CPR
- Fetch heart board, emergency suitcase, and defibrillator in the corridor

Simulation is discontinued when the emergency service arrives and takes over responsibility. The patient is then revived and they regain contact with her.

Appendix 3

Approval by the Norwegian Social Science Data Services

(no 18063) (in Norwegian)

Norsk samfunnsvitenskapelig datatjeneste AS
NORWEGIAN SOCIAL SCIENCE DATA SERVICES

NSD

Harald Hårfagres gate 2
N-5007 Bergen
Norway
Tel: +47-55 58 21 17
Fax: +47-55 58 96 50
nsd@nsd.uib.no
www.nsd.uib.no
Org.nr. 985 321 884

Sissel Eikeland Husebø
Institutt for helsefag
Universitetet i Stavanger
4036 STAVANGER

Vår dato: 01.02.2008 Vår ref :18063 / 2 / JE Deres dato: Deres ref:

KVITTERING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 11.12.2007. Meldingen gjelder prosjektet:

18063	*Sykepleierstudenters læring i møte med teknologien -simulering som pedagogisk metode i sykepleierutdanningen*
Behandlingsansvarlig	*Universitetet i Stavanger, ved institusjonens øverste leder*
Daglig ansvarlig	*Sissel Eikeland Husebø*

Personvernombudet har vurdert prosjektet og finner at behandlingen av personopplysninger er meldepliktig i henhold til personopplysningsloven § 31. Behandlingen tilfredsstiller kravene i personopplysningsloven.

Personvernombudets vurdering forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, eventuelle kommentarer samt personopplysningsloven/-helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/forsk_stud/skjema.html. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, http://www.nsd.uib.no/personvern/prosjektoversikt.jsp.

Personvernombudet vil ved prosjektets avslutning, 01.09.2011, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Bjørn Henrichsen — Janne Sigbjørnsen Eie
Bjørn Henrichsen — Janne Sigbjørnsen Eie

Kontaktperson:Janne Sigbjørnsen Eie tlf: 55 58 31 52
Vedlegg: Prosjektvurdering

Avdelingskontorer / District Offices
OSLO: NSD. Universitetet i Oslo, Postboks 1055 Blindern, 0316 Oslo. Tel: +47-22 85 52 11. nsd@uio.no
TRONDHEIM: NSD. Norges teknisk-naturvitenskapelige universitet, 7491 Trondheim. Tel: +47-73 59 19 07. kyrre.svarva@svt.ntnu.no
TROMSØ: NSD. SVF, Universitetet i Tromsø, 9037 Tromsø. Tel: +47-77 64 43 36. nsdmaa@sv.uit.no

Personvernombudet for forskning

Prosjektvurdering - Kommentar

18063

Utvalget består av sykepleierstudenter og universitetslektorer.

Det legges til grunn at utvalget informeres om alle sider av prosjektet. Det vises til informasjonsskriv til deltakerne vedlagt meldeskjema og forutsettes at følgende endringer gjøres i begge skriv:

- "Anonymisert" bør fjernes fra setningen "Videoopptakene og lydbåndopptakene blir behandlet konfideniselt og anonymisert", da innholdet på opptakene gjør at disse ikke kan karakteriseres som anonyme.
- Det må tilføyes dato for prosjektslutt.

Prosjektet skal avsluttes 1. september 2011 og datamaterialet vil da anonymiseres og videoopptak og lydopptak vil slettes.

Appendix 4

Approval by the University of Stavanger

Universitetet
i Stavanger

Sissel Eikeland Husebø
Universitetet i Stavanger
4036 Stavanger

Deres ref.: Vår ref.: 2008/903/KMS Dato: 12.02.2008

Ad. Forskningsprosjektet Sykepleirstudenter læring i møte med teknologien – tilsagn om behandling av personopplysninger.

Viser til Kvittering på melding om behandling av personopplysninger fra NSD og vurderingen om at prosjektet er meldepliktig i henhold til personopplysningsloven.

Vi ønsker deg lykke til med prosjektet og forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, eventuelle kommentarer samt personopplysningloven/-helseregisterloven med forskrifter.

Med vennlig hilsen

Kristel M. Skorge

Kristel Skorge
Underdirektør, kontaktperson for personvernsombudordningen ved UiS

Saksbehandler: Kristel Skorge, tlf.: 51 83 30 58

Rektor/direktør
Forskningssekretariat

Arne Rettedals hus

Universitetet i Stavanger
4036 Stavanger
Org.nr. 971564679

All post/e-post som inngår i saksbehandling, bes adressert til UiS og ikke til enkeltperson.

Telefon: 51 83 10 00
Telefaks: 51 83 10 50
E-post: post@uis.no
www.uis.no

Appendix 5

Statement by the Norwegian Regional Committee for Research Ethics

(in Norwegian)

"Arne Kristian Salbu " <Arne.Salbu@medfa.uib.no
>

30.10.2007 08:42

To <sissel.i.husebo@uis.no>
cc Beate Indrebø Hovland <beate.hovland@ldh.no>
bcc
Subject RE: SV: Vurdering fra REK

Spørsmålet er allerede besvart av Beate Husebø, ser jeg, til tross foss for at hun selv sier at det er REK som har ansvaret. Vi er da ferdig med saken

Vennlig hilsen
Arne Salbu
Regional komité for medisinsk og helsefaglig forskningsetikk, Vest-Norge (REK Vest)
Tlf: 55 97 84 98 (dir), 55 97 50 00 (sentr)
Postadr: Postboks 7804, 5020 Bergen.
Besøksadr: Haukeland Universitetssykehus, Sentralblokken,2.etg. rom 4617

From: sissel.i.husebo@uis.no [mailto:sissel.i.husebo@uis.no]
Sent: Friday, October 26, 2007 12:34 PM
To: rek-vest@uib.no
Subject: Fw: SV: Vurdering fra REK

Hei, jeg feilsendte dokumentene første gangen!

Hilsen
Sissel Eikeland Husebø
Universitetslektor/kurskoordinator for SAFER
Universitetet i Stavanger
Det samfunnsvitenskapelige fakultet
Institutt for helsefag
Tlf.a. 51834194/m. 95897983

4036 Stavanger
E-post sissel.i.husebo@uis.no

----- Forwarded by Sissel I Husebø/VIT/UIS on 26.10.2007 12:32 -----
Beate Indrebø Hovland <beate.hovland@ldh.no>

26.10.2007 10:44

To <sissel.i.husebo@uis.no>
cc
Subject SV: Vurdering fra REK

Hei tilbake,
dette er en forespørsel du må sende direkte til REK i din region. Det er REK som er førsteinstansen som skal ta stilling til hvilke prosjekter som er framleggingspliktige og ikke (en rask gjennomlesning tilsier at ditt prosjekt ikke er det, men det er altså REK som har forvaltningsmyndighet til å avgjøre dette).
Vennlig hilsen
Beate I. Hovland

Fra: sissel.i.husebo@uis.no [mailto:sissel.i.husebo@uis.no]
Sendt: 26. oktober 2007 10:27
Til: Beate Indrebø Hovland
Kopi: febe.friberg@uis.no
Emne: Vurdering fra REK

Hei!
Jeg planlegger mitt empiriske arbeid i forbindelse med min doktoravhandling, og ønsker en vurdering på om studien må sendes til REK for etisk vurdering. Er det flere dokumenter du trenger for å vurdere om studien skal til REK?

Jeg legger kopi av min forespørsel til min hovedveileder Febe Friberg, førsteamanuensis ved Institutt for helsefag, Universitetet i Stavanger.

Her kommer prosjektbeskrivelsen:

Arbeidstittel: Sykepleierstudenters læring i møte med teknologien-simulering som pedagogisk metode i sykepleierutdanningen

Introduksjon: I forhold til sykepleierstudentenes mulighet for å utvikle sin sykepleiekompetanse i løpet av utdanningen, har utviklingen i spesialisthelsetjenesten med nedbygging av sykehussenger og kortere liggetid for pasienter medført at sykepleierstudentene får reduserte muligheter til å praktisere ferdigheter (Norvoll, 2002b:181; Simpson, 2002). Et eksempel på dette som også er vel dokumentert de siste 15-20 år, er at helsepersonell, blant annet sykepleiere og sykepleiestudenter, har for lite ferdigheter knyttet til pasienter som får hjertestans (Badger & Rawstorne, 1998; Greig et al., 1996; Hamilton, 2005; Linnard-Palmer, 1996; Madden, 2006). I Norge er det hvert år rundt 18 000 personer med akutt hjerteinfarkt og omtrent 15 000 med angina pectoris som innlegges i sykehus (Al-Ani, Henriksen, Halvorsen og Sirnes, 2007). Akutt hjerteinfarkt er fortsatt den vanligste dødsårsaken i Norge så vel som i øvrige land i vest-Europa (Juhlin, 2001). Hvert år rammes 6000-8000 personer av plutselig hjertestans i Norge. Hos to av tre skjer hjertestansen utenfor sykehus (Norsk Resuscitasjonsråd, 2002).
Mange metoder for å forbedre ferdigheter i hjerte- og lungeredning (HLR) har vært utprøvd, men både innhold og metoder i forhold til HLR mangler fortsatt standardisering (Hamilton, 2005). Hamilton (2005) og Long (2005) løfter fram simulering av scenarier med hjertestans som en metode for å forbedre og opprettholde ferdigheter hos helsepersonell og studenter. Simulering er i mange år blitt brukt til treningsformål innen militære, aviasjon og kjernekraftindustri. Det er først i de senere årene at simulering er blitt tatt i bruk innen anestesisykepleie, medisin og sykepleie (Monti et al., 1998). Issenberg og kollega (2005) gjorde en "Best Evidence Medical Education (BEME) review" med den hensikt å undersøke om det var vitenskapelig grunnlag for å hevde at medisinsk simulering medførte effektiv læring. Forskerne konkluderte med at kvaliteten på forskningen må forbedres, og at medisinsk simulering gir et læringsutbytte og komplimenterer den medisinske utdanning relatert til pasientsituasjoner. Innen sykepleie gjorde Hamilton (2005) en gjennomgang av 105 studier om simulering som viste at trening på pasientsimulator bidro til gjenkjennelse av syke pasienter, trening på gjeldende retningslinjer og ulike situasjoner med hjertestans. Hamilton (2005) og Long (2005) konkluderer med at det trengs mer forskning for å dokumentere læringsutbytte og hva teknologien betyr i denne sammenheng.

Hensikt: Hensikten med prosjektet er å utforske og beskrive hvordan teknologi, dvs. simulering, bidrar i sykepleierstudentenes læring av beslutningstaking i en akuttsituasjon med hovedvekt på 1) hva som kjennetegner interaksjonen i studentgruppen i forhold til beslutningstakingsprosessen og 2) hvilke erfaringer sykepleierstudentene selv løfter fram som muligheter og begrensninger i læringen av beslutningstaking i forbindelse med simulering av en akutt pasientsituasjon.

Teoretisk rammeverk: Studiens teoretiske rammeverk tar utgangspunkt i ethnomethodologi (EM)(Garfinkel, 1967). Fra et EM perspektiv blir alt sosialt liv produsert innenfra av medlemmene av samfunnet, og oppgaven til EM er å identifisere metodene i denne produksjonen. Med referanse til utdanningsmessige fenomener, menes det at EM forsker på hvordan virkeligheten i utdanninger, som daglige aktiviteter i klasserom, først og fremst blir produsert (Hester & Francis, 2000). Teori om sosiokulturell læring, interaksjon, beslutningstaking, og Computer Supported Colloborative Learning er også inkludert i rammeverket.

Metode: Ca. 50 sykepleierstudenter fra 3.studieår i Bachelorutdanningen i sykepleie ved Institutt for helsefag vil rekrutteres til studien. Det vil benyttes interaksjonsanalyse av videoopptak fra simuleringen i forhold til hensikt 1), og fokusgruppeintervju i forhold til hensikt 2). Videoinnspilninger fra simuleringen samt båndopptak av fokusgruppeintervjuene i studentgruppene vil utgjøre data. Båndopptak med samtalene vil bli transkribert ordrett og ligge til grunn for analysen. Videoinnspilninger transkriberes også.

I tillegg kan jeg opplyse om at det vil utarbeides skriftlig informasjon til studentene om prosjektet, og at de også vil bli muntlig informert. Det vil også bli innhentet Samtykkeerklæring. Begge dokumenter vil følge "Hovedpunktene i de etiske vurderingene i de regionale komiteer for medisinsk forskningsetikk (REK)" som er skrevet av professor Grethe Seppola Tell, og som er tilgjengelig på http://www.etikkom.no/kontakt

Vennlig hilsen
Sissel Eikeland Husebø
Doktorgradsstudent/kurskoordinator for SAFER
Universitetet i Stavanger
Det samfunnsvitenskapelige fakultet
Institutt for helsefag
Tlf.a. 51834194/m. 95897983

4036 Stavanger
E-post sissel.i.husebo@uis.no