“BEING-IN-THE-WORLD”

Teaching clinical reasoning skills to nursing students through a serious game

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SUMMARY

Background: Nursing education faces the challenge to educate registered nurses (RNs) with a high level of clinical reasoning skills and evidence-based knowledge, who are able to provide safe and effective care to patients. Nursing educators are also challenged to develop innovative and effective programs that align with current changes in health care. Serious games (SGs) are computer-based simulations that may provide nursing students with an opportunity to practice their clinical reasoning and decision-making skills in realistic situations from the "real world" of clinical practice.

Purpose: The overall purpose of this project was to study recently graduated RNs' clinical reasoning in clinical practice settings, and to use this knowledge to design, develop and evaluate an SG prototype for teaching clinical reasoning and decision-making skills to nursing students. Showing the SG's educational value and user acceptance among nursing students could justify the development and application of more SGs in nursing education.

Designs, methods and samples: In Study I, an explorative qualitative think-aloud (TA) design with protocol analysis was used to describe the cognitive processes and thinking strategies used by recently graduated RNs while providing care for patients in home healthcare clinical practice. A purposive sample of eight RNs participated in three TA interviews each, for a total of twenty-four home healthcare visits. Additionally, eight follow-up interviews with the RNs were conducted. In Study II, a video-based SG prototype was developed for teaching clinical reasoning and decision-making skills to nursing students who care for patients with chronic obstructive pulmonary disease (COPD). The SG was developed based on the results from Study I, theory and research related to SG design, experiential learning theory and decision-making theory. A purposive sample of six participants evaluated the first scenario of the SG prototype in a usability laboratory. The first SG scenario was from a home healthcare setting. Cognitive walkthrough evaluations, a questionnaire and individual interviews were used. In Study III, a pilot study was conducted of the final SG with a convenience sample of 249 second-year nursing students. The final SG prototype included two scenarios from a home healthcare setting and two scenarios from a hospital setting. The pilot study involved the implementation of the SG prototype as part of two simulation courses in the Bachelor of Nursing program: one for students attending home healthcare clinical placements and one for students attending clinical placements in medical-surgical wards in hospitals. A paper-based survey was then

used to assess the nursing students' perceptions of the SG's educational value in terms of the SG's degree of realism/authenticity (face validity), alignment of content and tasks with curricula (content validity), and the SG's ability to meet the learning objectives (construct validity). In addition, the survey assessed perception of usability, individual factors, and preferences regarding future use. A total of 120 participants completed the survey, representing 48% of the nursing students in the two simulation courses.

Results: Study I showed that RNs with one year of clinical practice used both simple and complex cognitive processes and utilized metacognitive skills and ethical reasoning. They also demonstrated the use of inductive and deductive reasoning. However, the clinical reasoning of the RNs was highly influenced by domain-specific knowledge and the context. In addition, their reasoning was more reactive than proactive. Furthermore, knowing patients well could have both positive and negative effects on clinical reasoning. The SG prototype developed in Study II was perceived as having a content that was realistic and clinically relevant, and as having an adequate level of complexity for the intended users. Despite some perceived usability issues, most of the six participants agreed that the SG was useful, usable, and satisfying. Necessary improvements were made and the remaining three SG scenarios, one from a home healthcare setting and two from a hospital setting, were completed. Pilot testing of the final SG prototype in Study III, showed that most students from both the medical-surgical and home healthcare simulation courses perceived the SG as realistic, educationally valuable and easy to use. No significant differences were found in perception of realism or educational value between nursing students with or without previous work experience in healthcare. However, significantly more students in the home healthcare simulation course indicated that the SG tested their clinical reasoning and decision-making skills. Students from both simulation courses agreed that more video-based SGs should be developed and used in nursing education, especially in care for patients with chronic diseases.

Conclusion: The results support the idea that experiential learning through video-based SGs may aid students' clinical reasoning, for example through heightening nursing students' awareness in promoting systematic assessment of patients, improving recognition of patient deterioration and choosing appropriate interventions in specific situations. The positive attitudes towards the SG and the call for more and similar SGs within other areas of nursing education strongly support further development of this kind of technology-enhanced learning in nursing education.

NORSK SAMMENDRAG

Bakgrunn: Norsk sykepleierutdanning har som mål å utdanne sykepleiere med god refleksjonsevne, beslutningsevne og evne til å anvende forskningsbasert kunnskap, slik at de kan utøve trygg og effektiv sykepleie til pasientene. I tillegg utfordres sykepleierutdanningene til å utvikle innovative og effektive utdanningsprogram som imøtekommer endringer i dagens helsetjenester. «Serious games» (SGs) er en form for PC-basert simulering som kan tilby sykepleierstudentene en mulighet til å trene sin refleksjons- og beslutningsevne i konstruerte situasjoner (scenarier) fra den «virkelige verden» i klinisk praksis.

Hensikt: Den overordnede hensikten med prosjektet var å studere nylig uteksaminerte sykepleieres refleksjonsevne i klinisk praksis og å benytte denne kunnskapen til å designe, utvikle og evaluere en SG prototype med intensjon om å øke sykepleierstudentenes refleksjons- og beslutningsevne. Ved å synliggjøre SG prototypens læringsverdi og få aksept blant sykepleierstudentene, kan man forsvare utvikling og implementering av flere tilsvarende videobaserte SG i dagens sykepleieutdanning.

Design, metoder og utvalg: I studie I ble det benyttet et eksplorativt og kvalitativt «think-aloud» design (TA) med protokollanalyse for å beskrive de kognitive prosessene og tankestrategiene som nyutdannede sykepleiere benytter under utøvelse av sykepleie til pasienter i hjemmesykepleien. Et hensiktsmessig utvalg på åtte nyutdannede sykepleiere deltok i tre TA-intervjuer hver, under tilsammen 24 hjemmebesøk hos pasienter i hjemmesykepleien. I tillegg ble det gjennomført oppfølgingsintervju med hver enkelt sykepleier. I studie II ble det utviklet en videobasert e-læringsressurs av typen SG for å øke sykepleierstudentenes refleksjons- og beslutningsevne ved sykepleie til pasienter med kronisk obstruktiv lungesykdom. SG prototypen ble utviklet på bakgrunn av resultatene fra studie I, teori og forskning relatert til SG design og teori innenfor erfaringsbasert læring og beslutningstaking. I studie II testet og evaluerte et hensiktsmessig utvalg på seks deltakere den første versjonen av SG prototypen (et scenario fra en hjemmesykepleie setting) i et brukervennlighets-laboratorium. Kognitiv «walk-through» metode, spørreskjema og individuelle intervjuer ble benyttet. I studie III ble den ferdige SG prototypen (inneholdt to scenarier fra en hjemmesykepleie setting og to scenarier fra en sykehus setting) pilottestet på et utvalg av 249 andre-års sykepleierstudenter. Pilottesten ble utført ved implementering av SG prototypen som en del av to simuleringskurs ved

bachelorutdanningen i sykepleie: et for studenter som skulle ha praksis i hjemmesykepleie og et for studenter som skulle ha praksis i medisinske og kirurgiske avdelinger på sykehus. Et papirbasert spørreskjema ble deretter benyttet for å innhente informasjon om studentenes opplevelse av SG prototypens læringsverdi relatert til realisme og samsvar med pensum og læringsmål. I tillegg ble det innhentet vurdering av SG prototypens brukervennlighet, individuelle faktorer og preferanser angående fremtidig bruk. I alt 120 (48%) av studentene fullførte undersøkelsen ved de to simuleringskursene.

Resultater: Sykepleierne i studie I benyttet både enkle og komplekse kognitive prosesser som også inkluderte metakognisjon og etisk refleksjon. De demonstrerte i tillegg bruk av både induktiv og deduktiv refleksjon. Deres refleksjon var imidlertid preget av domene-spesifikk kunnskap fra hjemmesykepleien og tilhørende kontekst. I tillegg var refleksjonen mer reaktiv enn proaktiv. Det å kjenne pasientene godt hadde både positiv og negativ innvirkning på sykepleiernes refleksjon. De fleste av deltakerne i studie II var enige om at SG prototypen var nyttig, brukbar og tilfredsstillende å bruke til tross for noen utfordringer ved utprøving av ressursen. Nødvendige forbedringer ble utført, og de resterende tre SG-scenariene, et fra hjemmesykepleie og to fra sykehus, ble ferdigstilt. Utprøvingen av SG prototypen på sykepleierstudenter i studie III viste at de fleste studentene fra begge simuleringskursene opplevde at SG prototypen var realistisk, hadde stor læringsverdi og var enkel å bruke. Det ble ikke funnet noen signifikante forskjeller i oppfatningen av realisme eller læringsverdi mellom sykepleiestudenter med eller uten tidligere arbeidserfaring innenfor helsevesenet. Signifikant flere sykepleiere i simuleringskurset innenfor hjemmesykepleie mente at læringsressursen testet deres refleksjons- og beslutningsevne. Studentene fra begge simuleringskursene var imidlertid enige om at flere video-baserte SG bør utvikles og implementeres i sykepleieutdanningen, spesielt innenfor omsorg for pasienter med kroniske sykdommer.

Konklusjon: Resultatene støtter ideen om at erfaringsbasert læring gjennom videobaserte SG kan bidra til å øke sykepleierstudentenes refleksjonsevne, for eksempel ved å øke deres bevissthet når det gjelder systematisk undersøkelse og vurdering av pasienter. Dette gjelder både identifisering av forverring i pasienters tilstand, og for å velge passende tiltak i bestemte situasjoner. De positive tilbakemeldingene vedrørende SG prototypen og ønsket om flere lignende læringsressurser også innenfor andre områder av sykepleieutdanningen, støtter videre utvikling av denne typen teknologistøttet undervisning i sykepleierutdanningen.

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LIST OF PAPERS

This thesis is based on the following original papers

I. Johnsen, H. M., Slettebø, Å., & Fossum M. (2016). Registered nurses' clinical reasoning in home healthcare clinical practice: A think aloud study with protocol analysis, Nurse Education Today: Vol. 40, 95–100. http://dx.doi.org/10.1016/j.nedt.2016.02.023

II. Johnsen, H. M., Fossum, M., Vivekananda-Schmidt, P., Fruhling, A., & Slettebø, Å. (2016). Teaching clinical reasoning and decision-making skills to nursing students: Design, development, and usability evaluation of a serious game, International Journal of Medical Informatics, Vol. 94, 39–48. http://dx.doi.org/10.1016/j.ijmedinf.2016.06.014

III. Johnsen, H. M., Fossum, M., Vivekananda-Schmidt, P., Fruhling, A., & Slettebø, Å. (2018). Nursing students' perceptions of a video-based serious game's educational value: A pilot study, Nurse Education Today: Vol. 62, 62-68. https://doi.org/10.1016/j.nedt.2017.12.022

ABBREVIATIONS

AA	Assertional Analysis
CDMM	Clinical Decision-Making Model
COPD	Chronic Obstructive Pulmonary Disease
DMM	Decision-Making Model
ICN	International Council of Nurses
IPT	Information Processing Theory
ISBAR	Identify, Situation, Background, Assessment and Recommendation
LMS	Learning and Management System
LTM	Long Term Memory
NNO	Norwegian Nurses Organization [Norsk Sykepleierforbund - NSF]
NSD	Norwegian Centre for Research Data
Ph.D.	Philosophiae Doctor
PSSUQ	Post-Study System Usability Questionnaire
RCT	Randomized Controlled Trial
RN(s)	Registered Nurse(s)
RPA	Referring Phrase Analysis
SA	Script Analysis
SG	Serious Game
STM	Short Term Memory
TA	Think-Aloud
TEL	Technology Enhanced Learning
TURF	Task, User, Representation and Function
UiA	University of Agder

FIGURES AND TABLES

Figures:

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1.0 INTRODUCTION

Errors in health personnel's clinical reasoning represent a critical type of error that may influence patient safety. Poor clinical reasoning skills may decrease the ability to recognize deteriorating patients and to intervene appropriately. This may avert or delay proper treatment and lead to critical disease and even death of patients (National Academies of Sciences, 2015; The Norwegian campaign for patient safety, 2017). Thus, for registered nurses (RNs) to provide safe and effective care, it is recommended to enhance RNs' education and training in development of clinical reasoning skills (Benner, Sutphen, Leonard, & Day, 2010; National Academies of Sciences, 2015). Clinical reasoning comprises all the processes of thinking (reasoning) and decision-making that are associated with clinical practice (Alfaro-LeFevre, 2013b; Higgs & Jones, 2008). Teaching nursing students to reason clinically is important to enhance their ability to detect the right cues, take the right action for the right patient at the right time and for the right reason (Levett-Jones, Hoffman, Dempsey, Jeong, Noble, Norton, Roche, & Hickey, 2010). This includes teaching them to be proactive and to be responsive to changes in different healthcare contexts (Higgs & Jones, 2008).

To develop nursing students' clinical reasoning skills, nursing education should provide students with the ability to engage in clinical practice-like learning experiences where they need to learn to use different kinds of knowledge and practice thinking in changing situations and for the good of each patient (Benner et al., 2010). In current nursing education, such experience is provided through placement in clinical practice and through simulation-based training (Benner et al., 2010; Gaberson, Oermann, & Shellenbarger, 2014; University of Agder, 2014). However, the scarcity of clinical placements, restrictions on the number of students placed in units, and limits in resources and capacity for laboratory-based simulations (Gaberson et al., 2014) challenge nursing education and make it difficult to provide clinical learning experiences for all students.

An additional challenge in current nursing education is to provide variation in teaching and learning strategies that include technology enhanced learning (TEL) (Hallin, 2014; Montenery, Walker, Sorensen, Thompson, Kirklin, White, & Ross, 2013; Norway Opening University, 2015), as the millennium generation of nursing students prefer learning through experimentation, active participation, and multitasking with rapid shifts between technological devices (Montenery et al., 2013; Norway Opening University, 2015).

Serious games (SGs) are computerized simulations that may provide nursing students with an opportunity to practice their clinical reasoning and decision-making skills in a realistic and safe environment. In addition, SGs incorporate gaming components like multimedia and scoring, and these may stimulate motivation and learning (Heinrichs, Davies, & Davies, 2013; Ribaupierre, Kapralos, Haji, Stroulia, Dubrowski, & Eagleson, 2014). In line with the Heideggerian perspective "Being-in-the-world", SGs may provide nursing students with experiences from simulated scenarios in which they may practice being a nurse in the "real world" of clinical practice.

The purpose of this three-year PhD project has been to study recently graduated RNs' clinical reasoning in clinical practice settings and to use this knowledge to design, develop and evaluate an SG prototype for teaching clinical reasoning and decision-making skills to nursing students. Showing the SG's educational value and user acceptance among nursing students could justify the development and application of more SGs in nursing education.

1.1 Research approach

The ontology of this project builds on Martin Heidegger's (1889-1976) ontology and perspective "Being-in-the-world" (Schmitt, 2000). Like Heidegger (Schmitt, 2000), this project rejects both a simple subjective stance, where individual thoughts and feelings are the primary reality, and a simple objective stance, where an objective physical world is the primary reality. "Being-in-the-world" (*Dasein*) is the fundamental unity of human beings and the physical world. Based on the chosen ontology, this project takes an epistemological approach, where clinical reasoning is viewed as both subjective and contextually constructed (Fonteyn & Ritter, 2008). Thus, nursing education and teaching are conceived of as operating in the three different but overlapping domains of qualification, socialization and subjectification (Biesta, 2012, 2016).

To reach a comprehensive understanding of the phenomena being studied, knowledge has been gained using both an interpretive and a positivist approach. Hence, both subjective (qualitative) and objective (quantitative) data have been gathered and combined. Furthermore, subjectivity is maintained through the researcher's own reflections on research, and objectivity through the collection of data and analysis. Methodologically, the aims of the studies have driven the choice of design and methods (Polit & Beck, 2010).

1.2 Disposition of the thesis

After this introduction, Chapter 2 provides background information concerning practical knowledge and competence in clinical reasoning, clinical reasoning, nursing education, and serious games. Chapter 3 presents the overarching theory of this project, and how it aligns with the context and chosen epistemology of this project. This chapter also includes an introduction of the framework for SGs' design and evaluation that has been employed to guide this project, along with an explanation of how the project's three studies align with the dimensions of the framework. In Chapter 4, the different aims of the project are presented, followed by Chapters 5 and 6 with methods and results from the overall project. Chapter 7 offers a detailed discussion of the overall results of the project. This chapter also provides methodological considerations and contributions of this project to research and nursing education. Finally, in Chapter 8, conclusions are drawn and implications for practice and suggestions for further research are introduced.

2.0 BACKGROUND

2.1 Practical knowledge and competence in clinical reasoning

Aristotle proposed that the three virtues of intelligence – episteme (science or scientific knowledge); phronesis (prudence or practical wisdom); and techne (art or technical skill) – are the basis for or answer to our way of dealing with situations in clinical practice (Lindseth, 2015). These are also known as propositional (descriptive or declarative) and non-propositional (procedural) knowledge (Lindseth, 2015; Wackerhausen, 2015). Phronesis is the unifying virtue, which is described as a kind of practical knowledge or wisdom, or the ability to judge the right end of action in a particular situation and make a wise choice (Haggerty & Grace, 2008; Lindseth, 2015; Svenaeus, 2003). The Aristotelian notions of practical knowledge may be linked to RNs' competence in clinical reasoning (Christensen, Jones, Higgs, & Edwards, 2008). Clinical reasoning skills among RNs refers to their ability to detect the right cues, take the right action for the right patient at the right time and for the right reasons (Levett-Jones et al., 2010). Like practical knowledge, clinical reasoning requires integration of both theoretical, ethical, and practical knowledge, also referred to in nursing as using one's head, heart and hands (Karoliussen, 2011). Competence in clinical reasoning is developed gradually through a process that comprises experience, reflection and contextual interaction (Benner et al., 2010).

2.2 Clinical reasoning in nursing

It is essential for RNs to have a high level of clinical reasoning skills, together with evidence-based (scientific) knowledge, to provide effective, safe and high quality nursing care (Benner et al., 2010). The terms clinical reasoning, critical thinking, clinical judgment, and decision-making are often used interchangeably (Alfaro-LeFevre, 2013b; Banning, 2008a; Simmons, 2010). However, in contrast with the term critical thinking, which includes reasoning both outside and inside of the clinical setting, clinical reasoning comprises all the processes of thinking (reasoning) and decision-making that are associated with clinical practice (Alfaro-LeFevre, 2013b; Higgs & Jones, 2008). Thus, in this project clinical reasoning is defined as:

> the cognitive processes and thinking strategies that nurses use to understand the significance of patient data, to identify and diagnose actual and potential patient problems, to make clinical decisions to assist in problem resolution, and to achieve positive patient outcome. (Fonteyn & Ritter, 2008, p. 236)

Hence, the nursing process, consisting of assessment, diagnosis, planning, implementation and evaluation, may be viewed as the foundation for clinical reasoning (Alfaro-LeFevre, 2013a).

Core dimensions of clinical reasoning are cognition, metacognition, and discipline-specific knowledge (Higgs & Jones, 2008; Simmons, 2010). Cognition comprises cognitive or thinking skills such as analysis, synthesis and evaluation of collected information. Thinking strategies, or heuristics, are mental rules of thumb, for example searching for information, recognizing a pattern, or setting priorities, that assist in reasoning (Fonteyn & Ritter, 2008). Metacognition is a kind of self-awareness, or thinking about one's own thinking, which serves to bridge knowledge and cognition. Discipline-specific knowledge comprises knowledge derived from theory and research and knowledge derived from professional and personal experience (Higgs & Jones, 2008). Additional dimensions of clinical reasoning include mutual decision-making, contextual interaction, task impact, and the ability to promote positive cognitive, affective and experiential growth among patients (Higgs & Jones, 2008).

Errors in clinical reasoning are commonly associated with habits of thinking and practice. For example, inexperienced or unreflective RNs may focus more on the presence or absence of specific patterns (i.e., cues and signs of patient deterioration) and overlook other potentially important information (Higgs & Jones, 2008). Studies have proposed that novice RNs tend to be more rule-governed and lack the ability to see the whole situation (Jensen, Resnik, & Haddad, 2008). In addition, novice RNs identify fewer cues than do expert RNs, and are limited in their ability to cluster cues during performance of clinical reasoning and decision-making (Jensen et al., 2008; Loftus & Smith, 2008; Simmons, 2010).

Research on RNs' clinical reasoning has mostly been conducted in clinical practice in hospitals (Hoffman, Aitken, & Duffield, 2009; Lee, Lee, Bae, & Seo, 2016) and/or through written, clinical scenarios (Fossum, Alexander, Göransson, Ehnfors, & Ehrenberg, 2011; Göransson, Ehnfors, Fonteyn, & Ehrenberg, 2008) or virtual scenarios (Forsberg, Ziegert, Hult, & Fors, 2014). More knowledge is needed on recently graduated RNs´ performance of clinical reasoning while caring for patients in home healthcare clinical practice. Nurse educators may use this knowledge as a basis for developing and implementing TEL to improve students´ clinical reasoning and decision-making skills.

2.2.1 Clinical reasoning and decision-making models

The concept of clinical reasoning has evolved from the application of clinical decision-making to the health professions (Simmons, 2010). Among the best-known decision-making models applied in nursing research are the information processing model and the intuitive-humanist model (Banning, 2008b; Simmons, 2010). These two decision-making models (DMM) will be discussed below, followed by a presentation of a third model which incorporates both models and best aligns with this project.

The first DMM, The information processing theory (IPT), was developed by Newell and Simon (1972) and describes cognitive processes during decision making. They posited that information is received as input data from both motor and sensory sources, and that this information is processed in the short term memory (STM) with pre-existing knowledge stored in the long term memory (LTM) to lead to an outcome like a decision (Newell & Simon, 1972). The hypothetico-deductive method, which guides health professionals in hypothesis generation and testing, is an example of a medical descriptive model of decision-making based on the IPT (Simmons, 2010). The theoretical approach derives from the field of cognitive (objective) science, where expertise is viewed as the capability of cognitive processing and rational problem solving. For example, expert RNs have a more structured knowledge base that makes it easier for them to recognize patterns and links, and draw inferences from patient data (Jensen et al., 2008).

The second DMM, The intuitive-humanist (subjective) model, focus on intuition as pattern recognition or knowledge gained from personal experience (Banning, 2008b). Benner and Tanner (1987, p. 23) define intuition as "understanding without a rationale." Factors that may characterize intuition are physical sensations like gut feelings and emotional awareness (Banning, 2008b). According to the intuitive-humanist model, intuition enriches the clinical decision-making process as a nurse gains more experience (Banning, 2008b). In alignment with this model, Benner (1984, 2004) introduced a model of skill acquisition in nursing adapted from Dreyfus and Dreyfus (1980), where nursing skills at different levels of practical training are ranked according to a scale of five levels of proficiency. These levels range from limited pattern recognition and analytical thinking (novice) to comprehensive understanding and intuition (expert).

It has been proposed that Benner's model of skill acquisition represents an interpretive philosophy rather than a theoretical model, as her qualitative research (interviews, experience, and/or observations) is oriented toward challenging the traditional notion of objective science (Altmann, 2007). In addition, the intuitive-

humanist model has been criticized for representing a 'non-scientific' type of knowledge (Altmann, 2007), proposing that competence is rooted in experience and not rational thinking (McGuirk & Methi, 2015). Other researchers have argued that the two decision-making models and approaches described above are not so distinct, but rather represent different ways of explaining or describing how RNs reason (Croskerry, 2013; Dowding, 2009). Hence, the two types of reasoning may be referred to as "intuitive" and "analytic" or as Type 1 and Type 2 processing (Croskerry, 2013; Wackerhausen, 2015). Intuitive reasoning is largely reflexive and autonomous, but can lead to biases, fallacies, and thinking failures. Analytic reasoning is conscious, deliberate and generally reliable, but the reasoning process is slower and more resource-intensive. Because intuitive reasoning may cause cognitive bias and be misleading in clinical practice situations, it should be followed by analytic reasoning and metacognition (Croskerry, 2013; Wackerhausen, 2015). Similarly, Føllestad (1994) argues that the pattern of interpretation is clearly hypothetico-deductive, and proposes that the hermeneutic (interpretive) method is the hypothetico-deductive method applied to a meaningful material such as texts, works of arts, actions, etc.

In a review of DMMs and research, Banning (2008b) introduces a third model of decision making named the clinical decision-making model (CDMM), a multidimensional model that incorporates elements from both IPT and pattern recognition (intuition) as a basis for decision making (Banning, 2008b; O'Neill, Dluhy, & Chin, 2005). The clinical decision-making model provides a theoretical understanding of RNs' decision-making processes and the development of clinical reasoning- and decision-making skills. Central features of this model include: investigation of pre-encounter patient data, anticipating and controlling risk, hypothesis generation, hypothesis-driven assessment, pattern recognition and hypothesis selection, situational and client modification, and provision of standard nursing care. To facilitate experimental learning and to assign meaning to situations, RNs need to use cognitive tools such as insight, information processing, perceptions and memory (Banning, 2008b; O'Neill et al., 2005). In accordance with this model, this thesis takes the position where clinical reasoning and decision making are considered to be both intuitive and analytic.

2.3 Nursing education

2.3.1 Structure and content of nursing education

The structure and content of nursing education in Norway is regulated by the government through a law regulating higher education (The Ministry of Education & Research, 2005) and national curriculum regulations for nursing education (The Ministry of Education & Research, 2008). In addition to national curriculum regulations, the Norwegian Agency for Quality Assurance in Education is an independent expert body under the Ministry of Education and Research that contributes towards quality assurance and enhancement in nurse education. Furthermore, nursing education in Norway is regulated by European policies for higher education, such as the Bologna process (Kyrkjebø, Mekki, & Hanestad, 2002; Råholm, Hedegaard, Löfmark, & Slettebø, 2010), The European Qualification Framework (The Ministry of Education & Research, 2011), and The World Health Organization's European standards for nursing and midwifery (Keighley, 2009). The International Council of Nurses (ICN) and The Norwegian Nurses' Organization (NNO) also play active roles in discussions about the content and quality of nursing education (Kyrkjebø et al., 2002). For example, the two organizations have developed ethical guidelines for nurses (The International Council of Nurses, 2012; The Norwegian Nurses Organization, 2016).

In accordance with national and international regulations and policies for higher education, nursing education is expected to promote development of the following competencies among nursing students: theoretical-analytical competence; practical competence; learning competence; social competence, and; professional ethics competence (Kyrkjebø et al., 2002; Råholm et al., 2010). Furthermore, nursing students are to be educated for "knowledge-based work", which means that their nursing should be based on evidence- and experience-based knowledge, but also knowledge provided through patients' experiences and participation (Råholm et al., 2010). Nursing education must provide nursing students with the knowledge, skills and insight necessary to work in the nursing profession and to be prepared to meet and adapt to society's needs (Råholm et al., 2010).

2.3.2 Teaching and learning strategies

In current nursing education, a combination of different teaching and learning strategies is employed. These include lectures, individual study, supervised group work, seminars, project work, skills training, simulation, and individual supervision

(Gaberson et al., 2014; University of Agder, 2014). Experience is provided through placement in clinical practice and through laboratory-based simulations (Benner et al., 2010; Gaberson et al., 2014; University of Agder, 2014). Important components of experiential learning are situated learning and reflection (Benner et al., 2010; A. Y. Kolb, Kolb, Passarelli, & Sharma, 2014). Situated learning refers to learning that derives from particular situations with specific patients (Benner et al., 2010). Reflection in action represents thinking that modifies what is being done while it is being done (Schön, 1983). Reflection on action refers to reflecting on experiences from clinical practice situations, or reflection on reflection (Schön, 1983). In nursing education, reflection is facilitated through problem-based learning (i.e., simulations or role-play), written cases, reflection notes from clinical practice situations and group discussions (Benner et al., 2010; Gaberson et al., 2014). In addition, concepts from Bloom's taxonomy's levels of thinking; remembering, understanding, applying, analyzing, evaluating and creating, are widely used tools to promote and evaluate cognition and reflection in relation to different student assignments (L. W. Anderson & Krathwohl, 2001; Whei Ming & Osisek, 2011).

An important pillar in adult learning, such as nursing education, is motivation for learning. For example, nursing students' intrinsic- or self-motivation may be influenced by individual constraints, experiences and preferences.(Abela, 2009). In addition, teachers are major sources of extrinsic motivation, as their teaching styles influence motivation and learning outcomes among students (Abela, 2009; Curran, 2014). Hence, teaching strategies and learning activities should be planned to actively motivate and engage learners in the learning process (Curran, 2014). In addition, the learning strategies should vary between being teacher-directed and student-directed, as not all adult learners are equally intrinsically motivated (Abela, 2009).

2.3.3 Challenges in current nursing education

The clinical learning environment has been identified as an important future challenge for nursing education in Norway, as in rest of Europe (Salminen, Stolt, Saarikoski, Suikkala, Vaartio, & Leino-Kilpi, 2010). Demographic changes and care reforms have resulted in a shift in healthcare delivery from hospital to home healthcare services. This shift entails increasing complexity in the provision of care, especially in managing healthcare to patients with geriatric conditions, disabilities, and chronic diseases (The Ministry of Health & Care Services, 2009; Word Health Organization, 2013b). It is crucial for RNs to be able to identify signs of deterioration at an early stage in order to prevent acute and critical disease and provide appropriate treatment

and care (The Norwegian campaign for patient safety, 2017). Accurate, timely and patient centered diagnosis and nursing care relies on health professionals' proficiency in clinical reasoning (National Academies of Sciences, 2015). This calls for a transformation of RN's education and training to improve clinical reasoning skills, create a greater alignment between nursing education and clinical practice (Benner et al., 2010; Gaberson et al., 2014; Word Health Organization, 2013b) and smoothen the transition from student to graduate nurse (The Ministry of Education & Research, 2012).

However, several challenges exist for providing clinical training in nursing education. These include: lack of clinical placements, restrictions on number of students placed in units; and limits in resources and capacity for laboratory-based simulations (Gaberson et al., 2014). Furthermore, governmental regulations (The Ministry of Education & Research, 2017) and survey responses from students on quality of study programs (The Norwegian Agency for Quality Assurance in Education, 2017) have put pressure on nursing education to offer high quality, updated and relevant educational programs that motivate learning and completion. For example, the millennium generation of nursing students has shown preference for learning through experimentation, active participation and multitasking with rapid shifts between technological devices (Montenery et al., 2013; Norway Opening University, 2015). Thus, nursing education should provide variation in teaching and learning strategies, including TEL (Hallin, 2014; Montenery et al., 2013; Norway Opening University, 2015). Computer-based simulations and game-based learning, like SGs or virtual games, are proposed as useful technologies that can improve learning and skills development while entertaining users (Girard, Ecalle, & Magnan, 2013; Ribaupierre et al., 2014; Wattanasoontorn, Boada, García, & Sbert, 2013).

2.4 Serious games

2.4.1 Simulations, serious games and games

The Society for Simulation in Healthcare defines simulation as:

> a technique that creates a situation or environment to allow persons to experience a representation of a real event for the purpose of practice, learning, evaluation, testing, or to gain

> understanding of systems or human actions. (Lopreiato, Downing, Gammon, Lioce, Sittner, Slot, Spain, & and the Terminology & Concepts Working Group, 2016, p. 33)

The degree to which the simulation replicates a real event and/or clinical practice context is referred to as fidelity or realism; and includes physical, psychological, and environmental elements (Lopreiato et al., 2016). Simulations are usually played out in a skills laboratory, with role-playing and the use of mannequins in different training scenarios so that students gain experience and enhance their knowledge and skills (Jeffries, 2005; Nehring & Lashley, 2009). Computer-based simulations, which rely on screen-based experiences, can also be used to facilitate experiences from clinical practice situations (Jeffries, 2005). Serious Games (SGs) represent one type of computer-based simulation, also known as web-based simulations, e-simulations or virtual simulations (Cant & Cooper, 2014). However, in contrast to simulation-based e-learning that focuses on technical skills or procedure training, SGs provide the opportunity for nursing students to experience clinical practice situations (through case-based patient scenarios) where they can practice their clinical reasoning and decision-making skills in a realistic and safe environment (Heinrichs et al., 2013; Ribaupierre et al., 2014). Moreover, in contrast with games, SGs primarily focus on education rather than entertainment (Lopreiato et al., 2016). Hence, SGs provide active, experiential, situated and problem-based learning (Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012; Girard et al., 2013). They also represent a learner-centered educational approach in which users control their learning process through interactivity (Ribaupierre et al., 2014; Ricciardi & De Paolis, 2014). In this thesis, an SG is defined as:

> a computer application whose intended purpose is to coherently combine both serious aspects such as, but not limited to teaching, learning, communication, or information, with game playing aspects from video games. Such a combination, functioning according to a utilitarian scenario, which in computer terms implements a sound and graphic package, a story and appropriate rules, and is therefore distinct from simple entertainment. (Lelardeux, Mountaut, Alvarez, & Lagarrique, 2013, p. 24).

Most SGs employ an interface using virtual patients in the form of images/pictures, animations or an avatar in a virtual environment to simulate real-life experiences (Cant & Cooper, 2014). Few SGs are video-based (Cooper, Porter, Bogossian, & Cant, 2014;

Kaczmarczyk, Davidson, Bryden, Haselden, & Vivekananda-Schmidt, 2015; Verkuyl, Atack, Mastrilli, & Romaniuk, 2016).

2.4.2 Research on SGs

SGs are identified as potential tools for consolidating and revising knowledge, as they facilitate formative assessment and provide an effective strategy for teaching both theory and practice (Annetta, 2010; Kaczmarczyk et al., 2015). Other identified benefits of SGs are increased student enthusiasm (intrinsic motivation) for learning and self-reflection, decreased fear and increased preparedness for the real clinical practice situations (Ambrosio Mawhirter & Ford Garofalo, 2016; Brull & Finlayson, 2016). Computer-based and online learning is also considered a flexible way of learning (Brull & Finlayson, 2016; Button, Harrington, & Belan, 2014). Negative aspects identified with computer-based learning are: users' computer literacy, an increased level of anxiety, unreliable computer systems (technical issues), lack of technical support, computer screen freezing, online connection dropout and/or download time (Button et al., 2014).

Types and numbers of SGs applied to medical or health-related purposes are growing rapidly (Cant & Cooper, 2014; Graafland, Dankbaar, Mert, Lagro, De Wit-Zuurendonk, Schuit, Schaafstal, & Schijven, 2014; Ricciardi & De Paolis, 2014). However, limited researchers have addressed the development process of SGs in the domain of nursing education (Foronda, Godsall, & Trybulski, 2013; Ricciardi & De Paolis, 2014). Even fewer have specifically addressed SG development related to care for patients in the domain of home health care (Hogan, Kapralos, Cristancho, Finney, & Dubrowski, 2011; Popil & Dillard-Thompson, 2015; Stuckless, Hogan, & Kapralos, 2014).

Due to varied aims of study and the nature of obtained results, studies have found it difficult to reach reliable conclusions concerning the effectiveness of SGs in learning (Connolly et al., 2012; Graafland et al., 2014). The effectiveness of SGs could also be influenced by various designers' insufficient understanding of SGs' design principles (Bellotti, Berta, De Gloria, Ott, Arnab, De Freitas, & Kiili, 2011; Graafland et al., 2014) and limited focus on validation in SGs' design (Graafland et al., 2014; Graafland, Schraagen, & Schijven, 2012; Mohan, Angus, Ricketts, Farris, Fischhoff, Rosengart, Yealy, & Barnato, 2014). More research on design and development of SGs is needed to ensure the development of educationally valuable SGs.

2.4.3 Development and evaluation of SGs

To design educationally valuable SGs, it is important to consider critical dimensions such as user specifications, pedagogy, representation (fidelity, interactivity and immersion) and context (Annetta, 2010; Arnab, Lim, Carvalho, Bellotti, de Freitas, Louchart, Suttie, Berta, & De Gloria, 2015; de Freitas & Liarokapis, 2011). For example, users of the SG should be able to be a part of the environment/context (Identity) and be engaged in the content (Immersion). Next, the SG should allow users to communicate with the game (Interactivity), provide different levels of challenge or difficulty (Increased complexity), provide embedded assessments and feedback (Informed teaching) and provide active and meaningful learning (Instructional) (Annetta, 2010). Hence, for an SG to meet its intended purpose there needs to be congruity between the SG's content and its components of representation, engagement and challenge (All, Nuñez Castellar, & Van Looy, 2015; Arnab et al., 2015; Boyle, Hainey, Connolly, Gray, Earp, Ott, Lim, Ninaus, Ribeiro, & Pereira, 2016). Consequently, it is essential to conduct usability evaluations in the process of SG development (Lazar, Feng, & Hochheiser, 2010; Moreno-Ger, Torrente, Hsieh, & Lester, 2012; Olsen, Procci, & Bowers, 2011). Usability is defined as:

> the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. (International Organization for Standardization, 1998)

Furthermore, it is crucial to conduct an evaluation of the final SG prototype with potential users to determine the SG's quality and educational value before implementation (Graafland et al., 2014; Russell, 2015). Nursing students' attitudes towards online courses may be impacted by both individual, academic course and technical factors (de Freitas & Liarokapis, 2011; Stott & Mozer, 2016). Thus, evaluation of an SG's educational value needs to include aspects like face, content and construct validity; that is, the SG's degree of realism/authenticity, alignment of content and tasks with the curriculum and the SG's ability to meet the learning objectives (Graafland et al., 2014). In addition, the evaluation needs to include components that promote acceptance and intention of future use (Venkatesh, Thong, & Xin, 2016). According to Venkatesh, Thong and Xin (2016), perceived usefulness is the strongest factor in relation to user acceptance and intention to use technology (such as an SG). In addition, intentions to use technology will depend on aspects such as the technology's usability and ability to engage/motivate, contextual factors like social

influence and facilitating conditions and on individual factors like age, gender, experience and voluntariness of use.

Many SGs have not undergone proper quality assurance, because this is considered a long and costly enterprise (Graafland et al., 2014). Consequently, SGs' educational value is most often measured in terms of users' performance outcomes regarding knowledge, skills or attitude (All, Nuñez Castellar, & Van Looy, 2016; Graafland et al., 2014; Liaw, Wong, Chan, Ho, Mordiffi, Ang, Goh, & Ang, 2015) rather than measuring aspects like the particular SG's face, content and construct validity (Graafland et al., 2014; Nicolaidou, Antoniades, Constantinou, Marangos, Kyriacou, Bamidis, Dafli, & Pattichis, 2015). More research is needed to develop instruments for measuring users' experience of SGs' educational value in order to ascertain SG's quality before implementation.

2.5 Rationale for this project

Nursing education faces the challenge to educate RNs with a high level of clinical reasoning skills and evidence-based knowledge, who are able to provide safe and effective care to patients. Nursing educators are also challenged to develop innovative and effective programs that align with current changes in health care. SGs are computer-based simulations that may provide nursing students with an opportunity to practice their clinical reasoning and decision-making skills in realistic situations from clinical settings. This kind of experiential learning may increase nursing students' ability of recognizing deteriorating patients, preventing acute and critical disease and providing appropriate treatment and care in different healthcare contexts.

Few papers have addressed the development process of SGs for use in nursing education. Even fewer have specifically addressed the development of SGs in relation to care of patients in the domain of home health care. More knowledge is needed on how to design and develop SGs that nursing students perceive as educationally valuable and attractive. Showing an SG prototype's educational value and user acceptance among nursing students could justify the development and application of more SGs in nursing education.

3.0 THEORETICAL FOUNDATION

As the title of this thesis indicates, Heidegger's ontology and perspective of "being-in-the-world" has been adopted and used as an overarching theory for teaching clinical reasoning skills to nursing students. This project has developed a video-based SG intended to provide experiences from simulated scenarios where nursing students may practice being a nurse in the "real world" of clinical practice.

In the first section, I briefly introduce Heidegger's ontology and how it aligns with the context and chosen epistemology of this project. An introduction follows to illustrate the framework for the SG design and evaluation employed to guide this project, including explanations on how the project's three studies align with the dimensions of the framework. Information about design and methods of each study will be provided in Chapter 5.

3.1 "Being-in-the-world"

The ontology and perspective "being-in-the-world" is based on existential phenomenology and was introduced by Martin Heidegger (1889-1976) (Strydom & Delanty, 2003). Heidegger (Schmitt, 2000) rejects both a simple subjective stance, where individual thoughts and feelings are the primary reality, and a simple objective stance, where an objective physical world is the primary reality. He argues that "being-in-the-world" (*Dasein*) is the fundamental unity of human beings and the physical world. We always live in a historical, cultural, and social relation which forms the nature of our being and the meaning of our language (Schmitt, 2000). We continuously find ourselves (*being thrown*) in situations where we interpret and act based on our being. Hence, to be (someone) in the world is a necessary feature of humans.

In his main work *Sein und Zeit* (Being and Time) from 1927, Heidegger describes existentials or categorical features that are common ways of being in the world (Schmitt, 2000). The two existentials that have been found to be particularly applicable to this project are the two key existentials; *befindlichkeit* (mood) and *versteen* (understanding). The way human beings find themselves in a particular situation is part of the existential 'mood'. It can refer to students' motivation or attitude towards learning, sense of abilities, and their capability of self-awareness (*erkennen*) and awareness of the world (Schmitt, 2000). The sense of one's abilities and one's mood makes humans turn to or away from situations (Schmitt, 2000). Heidegger considers the other chosen existential, 'understanding', a necessary feature of being. He proposes that understanding entails both knowing 'how to' and

understanding the properties of things, which he refers to as *present at hand* (non-propositional knowledge) and *ready to hand* (propositional knowledge). For example, students' understanding of how to do something also need to entail knowing certain rules (theoretical knowledge) and applying them correctly (Schmitt, 2000).

Heidegger emphasizes that one becomes through doing (practical experience), and that what we do exemplifies who we are. Thus, moods and understanding are viewed as two senses of cognitive knowing that always occur together. Heidegger (Schmitt, 2000, p. 196) argues that "the way one knows oneself and the world, affects what one is and what the world is". However, our (pre) understanding or implicit beliefs and assumptions can be made explicit and changed (by reinterpretation) through "breakdowns" or reflection on one's action (Schmitt, 2000). In the context of this project, students' moods and understanding, and their ability of reflection and reinterpretation are considered important aspects in development of students' clinical reasoning skills.

Based on Heidegger's proposition that humans' existence and "being-in-the-world" form the nature of our being and the meaning of our language (Schmitt, 2000), this project takes an epistemological approach where clinical reasoning is viewed as both subjective and contextually constructed (Fonteyn & Ritter, 2008). Education is viewed as a relational term, where education and teaching fall into the three different but overlapping domains: qualification, socialization and subjectification (Biesta, 2012, 2016). Qualification encompasses the acquisition of knowledge and skills, and to a certain extent values and dispositions. Socialization refers to the way in which individuals become part of existing traditions and practices (i.e., nursing profession). Subjectification includes the way in which education contributes to the formation of certain qualities of the individual person. Thus, to teach clinical reasoning skills to nursing students, we need to find the right balance among these three dimensions (Biesta, 2012).

3.2 Framework and theory

The four-dimensional framework for game design and evaluation by de Freitas and Oliver (2006) has been used to guide this project. In this framework, context, learner specifications, pedagogic considerations and mode of representation are proposed as essential dimensions in development of educational SGs. Figure 1 presents a self-developed model of the framework.

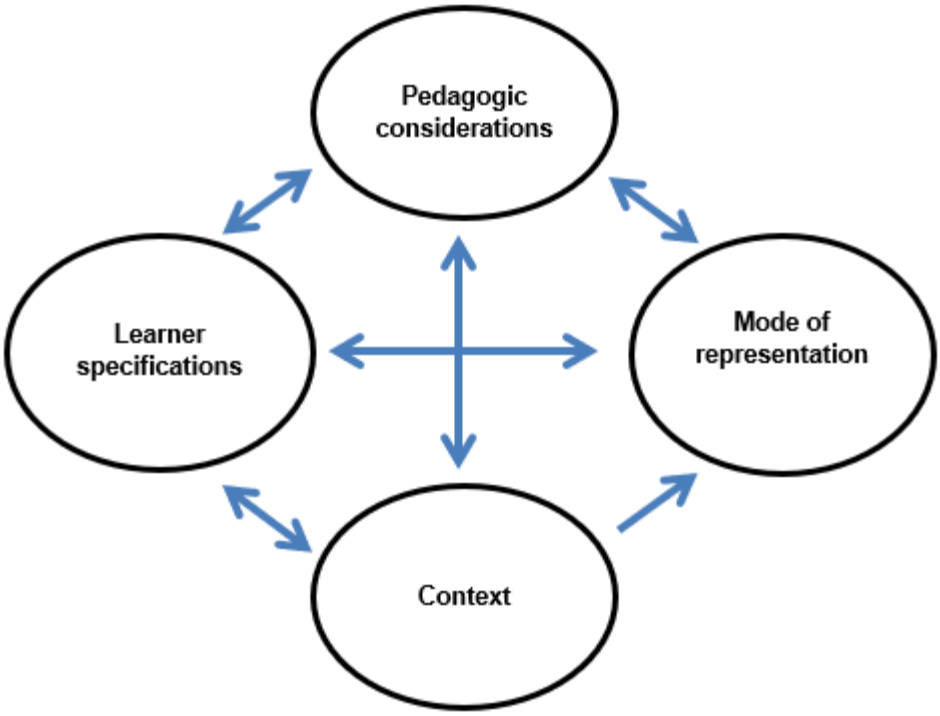


Figure 1: A self-developed model based on The Four Dimensional Framework by Freitas and Oliver (2006, p. 253).

According to de Freitas and Oliver (2006), context focuses on the particular context where play/learning takes place, including macro-level (historical, political and economic) factors as well as micro level factors (available resources and tools). Learner specifications focus upon attributes of the particular learners or group, such as age, level, learning background, styles and preferences. Pedagogic considerations focus on the processes of learning, i.e., the models and approaches adopted in pursuit of learning objectives. The processes of learning include both formal curricula-based learning and informal learning. Mode of representation includes aspects such as the interactivity and the levels of immersion or fidelity used in a game (de Freitas & Oliver, 2006). Each of the four dimensions encompasses aspects that are essential for effective adoption in educational processes. In addition, each of the dimensions relates to each other (de Freitas & Oliver, 2006).

3.2.1 Design and development of the Serious Game

Context

Based on Heidegger's ontology and the proposition that RNs' clinical reasoning is both subjective and contextually constructed, decisions had to be made on what context and patient group the SG should focus on. As recently graduated RNs need to

provide increasingly more complex patient care; especially in managing healthcare for patients with geriatric conditions, disabilities, and chronic diseases; the context of home healthcare and care for patients with chronic diseases was chosen. Further, based on results from Study I, an SG would be developed (Study II) that focused on provision of care for patients with chronic obstructive pulmonary disease (COPD). Since this patient group is highly represented in both home healthcare services and hospitals (The Ministry of Health & Care Services, 2013), the SG would provide scenarios from both the context of home healthcare and hospital. Further, as the context in SGs is intended to resemble a real clinical practice setting (de Freitas & Oliver, 2006), a video-based SG was made.

Other contextual aspects included considerations about available resources and tools for developing the SG. The SG was developed as an interdisciplinary collaborative project between professionals from the Faculty of Health and Sport Sciences and the Faculty of Engineering and Science at the University of Agder (UiA), clinical practice (Grimstad municipality and Sørlandet hospital), and four undergraduate students in the Bachelor Program in Multimedia Technology and Design. Necessary resources, tools and costs were shared between the departments and organizations involved.

Learner specifications

As proposed by Winograd and Flores (1987), and in line with Heidegger's ontology, the design and development of the SG was based on an understanding of human thinking, language, and being. For example, to decide on nursing students' needs, or what content and learning objectives should be focused on in the design of the SG, RN's performance of clinical reasoning in home healthcare clinical practice was assessed in Study I. Information was also gathered on the RNs' experiences with current nursing education with suggestions for improvements. Furthermore, as proposed by de Freitas and Oliver (2006), attributes of the SG target users (nursing students) were gathered through examination of the syllabus and curriculum in the Bachelor of Nursing program before development of the SG in Study II. In addition, information about individual learner attributes and preferences were gathered from participants in Study III.

Pedagogic considerations

In line with Heidegger's ontology and perspective of "being-in-the-world" (Section 3.1), nursing students' competence in clinical reasoning occurs gradually through a process that comprises experience, reflection, and contextual interaction (Benner et al.,

2010; Higgs & Jones, 2008). D. A. Kolb's (1984) experiential learning theory was found to fit this epistemology and the design of the SG in Study II. Experiential learning is defined as "the process whereby knowledge is created through transformation of experience" (D. A. Kolb, 1984, p. 41). This process takes place in a cyclical mode including the following four steps: concrete experience, reflective observation, abstract conceptualization, and active experimentation. In the SG, 'concrete experiences' are provided through four video-based scenarios from clinical practice situations with an RN and a man with COPD as actors. Through each SG scenario, students are 'thrown' into new situations that they need to interpret, reflect and act upon. 'Reflective observation', or testing of students' clinical reasoning- and decision-making skills, is facilitated through the provision of different quiz-based tasks that students need to solve based on information and cues provided in the scenarios. In line with clinical reasoning and decision-making theory (O'Neill et al., 2005), the tasks are related to gathering of information/patient assessment, identification of patient deterioration, making judgments and decisions, provision of appropriate treatment and care, and evaluation of applied treatment. The tasks and questions in the SG are based on the core dimensions of clinical reasoning, such as cognition, metacognition, and discipline-specific knowledge (Section 2.2). As such, they are specifically designed to stimulate the higher levels of thinking (analysis, synthesis, and evaluation) in Bloom´s taxonomy of learning objectives (L. W. Anderson & Krathwohl, 2001; Bloom, 1956). Furthermore, the students are provided with the opportunity to reflect on their decisions and choice of actions, as the SG provides correct answers and a demonstration of appropriate assessments and actions by the RN. This process facilitates 'concrete conceptualization', as the students need to apply theory to their experiences, decisions and choice of actions, and can internalize acquired knowledge and skills. In reference to Heidegger's ontology, the SG facilitates reflection and 'breakdowns' (reinterpretation) of students' understanding (Schmitt, 2000). Finally, in relation to 'active experimentation', students may transfer what they have learned through the SG scenarios to real clinical practice situations. A more detailed description of the SG is provided in Section 5.3.

Mode of representation

In line with Heidegger's perspective of "being-in-the-world", Winograd and Flores (1987) propose that users' experience, interpretation and understanding of the properties on the computer screen (interface) will depend on the representation (interface design, language/text and graphics) and user-computer interaction. Thus, to

ensure a user-centered design of the SG (Study II), theory and research related to SG design was employed (Section 2.4.3). Furthermore, since the four-dimensional framework (de Freitas & Oliver, 2006) does not include specified principles important to an SG's usability, the TURF unified framework was included in the process of SG development and evaluation in study II (Zhang & Walji, 2011). This is a framework used in both design and evaluation of information systems in the health care environment. It represents a theory for describing, explaining, and predicting usability. TURF stands for task, user, representation, and function. 'Task' means the SG should be easy to learn, easy to use and error tolerant. 'Users' means that users should perceive the SG as useful, usable and likable. 'Representation' means the formats of representation of the SG should be usable. Finally, 'function' means that the SG should fit the specific work domain and context. TURF also integrates the following usability heuristics from Nielsen and Shneiderman (Zhang, Johnson, Patel, Paige, & Kubose, 2003; Zhang & Walji, 2011): consistency, visibility, match, minimalist, memory, feedback, flexibility, message, error, closure, undo, language, control and document. Usability heuristics are predefined areas that are important to users' interpretations and understanding (Winograd & Flores, 1987).

Tools like game engine, database and design software application are also essential features to consider in relation to an SG's mode of representation (Laamarti, Eid, & El Saddik, 2014; Wattanasoontorn et al., 2013). However, these elements were the responsibility of undergraduate students and developers from the Faculty of Engineering and Science at UiA.

3.2.2 Evaluation of the SG's educational value

As proposed in Section 2.4.3, nursing students' attitudes (mood) towards SGs are impacted by factors including context, individuality, course, and technical aspects (de Freitas & Liarokapis, 2011; Stott & Mozer, 2016; Venkatesh et al., 2016). Thus, Study III assessed students' perceptions of the SG's educational value by including the following aspects: face, content and construct validity, usability, individual factors and preferences of future use of this kind of e-learning resource in the Bachelor of Nursing program. The SG's overall educational value will be discussed at the end of this thesis in relation to the chosen ontology, epistemology and applied framework.

4.0 AIMS

The purpose of this project has been to study recently graduated RNs' clinical reasoning in clinical practice settings, and to use this knowledge to design, develop and evaluate an SG prototype for teaching clinical reasoning and decision-making skills to nursing students. This thesis comprises three papers with the following aims:

I. Describe the cognitive processes and thinking strategies used by recently graduated RNs while caring for patients in home healthcare clinical practice.

II. Describe the design, development, and usability evaluation of a video-based SG for teaching clinical reasoning and decision-making skills to nursing students who care for patients with chronic obstructive pulmonary disease (COPD) in home healthcare settings.

III. Assess nursing students' perceptions of a video-based SG[1] in terms of face, content, and construct validity. In addition, assess perceptions of usability, individual factors, and preferences regarding future use.

[1] The SG included four scenarios which aimed to teach clinical reasoning and decision-making skills to nursing students caring for patients with COPD in both home healthcare and hospital settings

5.0 METHODS

The research approach of this project is pragmatic, where aims of the three studies have driven the choice of design and methods (Polit & Beck, 2010). Methods from both the positivist and interpretive paradigm are combined (Polit & Beck, 2010; Sale, Lohfeld, & Brazil, 2002). This will be further explained below. For example, Study I employed the 'think aloud' technique to collect verbal data and produce verbal protocols to assess the cognitive processes and thinking strategies used by recently graduated RNs. This technique is based on IPT, which is derived from cognitive psychology and seeks to explain cognitive activities such as mental structures and processes (Ericsson & Simon, 1993). Most of this research within cognitive psychology has been experimental and has attempted to explain differences between novices and experts (Loftus & Smith, 2008). Even though the method generates qualitative data, the scientific research approach into clinical reasoning has been used predominantly within the positivist paradigm (Loftus & Smith, 2008; Strydom & Delanty, 2003). In this paradigm, most data are analyzed quantitatively. To further explore and arrive at a more comprehensive understanding of RNs' clinical reasoning in real-life practice settings, verbal protocols were complemented by observation and individual interviews with each nurse. Research methods like observation and interviews are situated within the interpretive or hermeneutic paradigm, which seek to interpret and understand phenomena, in particular human phenomena (Higgs, Jones, & Titchen, 2008; Strydom & Delanty, 2003). Hermeneutics is a philosophical approach building on phenomenology (Strydom & Delanty, 2003; Svenaeus, 2003). This approach aims to achieve a true interpretation of things by testing meaning or pre-understanding through reflection and negotiation in a social context (Svenaeus, 2003). Research design and methods for each study will be further explained in the following sections.

5.1 Research designs and methods

This thesis includes three studies reported in three papers (I-III). Data collection for the three studies was conducted between 2014 and 2016 in three different settings. Figure 2 shows the order and timeframe of the studies. Analysis of data from Study III and submission of paper III was conducted in 2016.

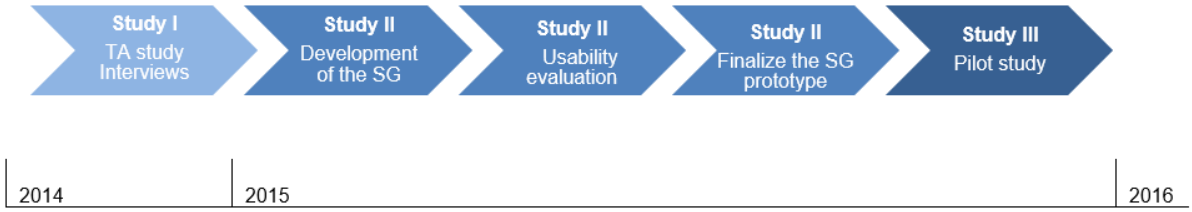


Figure 2: Overview of the research process

To meet the different aims of this project it was necessary to employ a combination of different data collection methods. An overview of designs, samples and research methods for the three studies is provided in Table 1.

The members of the research team in study I were Hege Mari Johnsen[2], Åshild Slettebø[2] and Mariann Fossum[2]. The members of the research team in study II and III were Hege Mari Johnsen, Mariann Fossum, Pirashanthie Vivekananda-Schmidt[3], Ann Fruhling[4] and Åshild Slettebø.

[2] Department of Health and Nursing Science, Faculty of Health and Sport Sciences, University of Agder, Grimstad, Norway
[3] Medical Education, The Medical School, University of Sheffield, UK
[4] School of Interdisciplinary Informatics, College of Information Science and Technology, University of Nebraska, Omaha, USA

Table 1: Overview of the study designs, research methods, settings and samples

Study	Design	Data collection	Setting	Sample	Data analysis
I	Explorative and descriptive design	Concurrent think-aloud (TA) interviews, observations and personal interviews	Seven home healthcare districts from seven municipalities in three counties in Southern Norway. The home of 24 patients diagnosed with COPD, diabetes or stroke.	Eight RNs with one year experience. Each RN was followed on three home visits.	Three-step protocol analysis was employed on the data from the TA interviews, representing both deductive and inductive content analysis. Thematic content analysis was conducted on the data from the personal interviews
II	Evaluative and descriptive design	Usability evaluation of the first SG scenario: Cognitive walkthrough evaluations, a survey, and personal interviews	Usability laboratory at UiA	Six participants: two RNs from one home healthcare setting, two third-year nursing students, and two university teachers from the Bachelor of Nursing program	Deductive content analysis was employed on the data from the cognitive walkthrough evaluations and personal interviews. Descriptive statistics was used on the survey data
III	Pilot study with evaluative and descriptive design	Survey to assess nursing students' perception of the final SG prototype (containing four video-based scenarios)	A school of nursing in Southern Norway. The SG was implemented as part of two simulation courses in nursing education.	A total of 249 nursing students in their second year of the Bachelor of Nursing program from two different campuses. Of these students, 120 (48%) completed a paper-based survey	Descriptive statistics Non-parametric statistics: Wilcoxon-Mann Whitney test, the Kruskal-Wallis test, and the Bonferroni-Holm adjustment Thematic content analysis was conducted on qualitative text data.

5.2 Study I

5.2.1 Sample and setting

Study I included a purposive sample (Polit & Beck, 2010) of eight RNs. The number of participants included was based on recommendations from similar studies, suggesting that between 5-10 participants is sufficient to gain rich, in-depth data (Fonteyn & Fisher, 1995; Fonteyn, Kuipers, & Grobe, 1993). Home healthcare ward managers assisted in recruiting the participants based on the following criteria: RNs with approximately one year of nursing experience and currently working more than 50% in the home healthcare district. In addition, the home healthcare district should be able to provide three different visits to patients within the selection of the three most common chronic diseases; COPD, diabetes and stroke. One or more patients with the same chronic disease could be recruited if patients from the other groups were unavailable. Due to difficulties in recruiting participants and finding home healthcare districts that had enough patients that met eligibility criteria, participants were recruited from seven different geographical districts of home healthcare within seven municipalities and three counties in Southern Norway.

5.2.2 Methods

Study I used a qualitative explorative design (Polit & Beck, 2010). Data was collected in 2014 using think-aloud (TA) interviews and semi structured interviews. The interviews were conducted according to an interview guide, which included background questions prior to the TA interview, instructions related to the TA interview and semi structured questions related to the follow-up interview (Appendix 1).

Think-aloud interviews

The TA method is described by Ericsson and Simon (1993) and has been successfully employed in nursing research to collect information about cognitive processes and thinking strategies (Fonteyn & Fisher, 1995; Forsberg et al., 2014; Fossum et al., 2011). Data was collected using a concurrent TA method, which means that the participants were interviewed and audiotaped while they were caring for their patients. Before each TA interview started, the RNs were instructed to verbalize their thoughts during problem-solving by thinking aloud. If necessary, brief remarks such as “please continue” or “please think aloud” were used to remind participants to continue thinking aloud during their visits. The advantage of collecting verbal data in real-time

situations is that it produces concurrent reasoning, which represents information processing from the working memory or so called short term memory (STM). A disadvantage of collecting retrospective verbalizations is that information must be retrieved from long term memory (LTM) and then verbalized. Consequently, the interview subject may retrieve information from long term memory that did not actually appeared in working memory during the problem solving task (Ericsson & Simon, 1993; Van Someren, Barnard, & Sandberg, 1994).

Semi structured interviews

Semi structured (Polit & Beck, 2010) follow-up interviews were conducted with the participants after the concurrent TA sessions. First, the participants were asked if they had additional information they wanted to add, i.e., information they had not said aloud out of consideration for patients. Second, they were asked whether they thought their experiences with these patient groups and individual patients influenced their clinical reasoning. Finally, they were asked questions about their experience with current nursing education, i.e., it's provision of knowledge and skills in relation to patients within the selected group of chronic diseases (stroke, COPD and diabetes), whether they missed any content in the nursing education syllabus, and ways in which they propose future nursing education might best prepare graduate RNs for their transfer to clinical practice.

5.2.3 Procedure

To practice and familiarize with the TA method, the Ph.D. student conducted a TA interview with a colleague in the university simulation laboratory. A member of the research team who was familiar with the TA method was present and provided instructions on the TA technique. In addition to the Ph.D. student's preparations, all the eight participants engaged in a practice TA session at the home healthcare office prior to their first formal TA session in a patients' home (Ericsson & Simon, 1993). They were encouraged to imagine that they were on a visit to a patient with diabetes that had a chronic leg ulcer. To conduct the TA technique in a correct manner, the participants were instructed to verbalize their thoughts rather than describing what they were doing and/or why. During this practice session, participants were corrected if they only described what they were doing instead of verbalizing their thoughts. After conducting a practice session with each participant, the doctoral student accompanied them to three different patients within the selected group of chronic diseases (COPD, stroke and diabetes) for the TA interviews. Between visits to the patients specifically

chosen for this study, the Ph.D. student had to wait in the service car during the route set by the participants. The follow-up interviews were conducted and recorded either at the home healthcare office or in the nurse's service car. Notes were not taken during the TA interviews, but were written simultaneously with the subsequent transcription of data from each participant.

5.2.4 Analysis

The Ph.D. student recorded, transcribed and analyzed the qualitative data. The TA interviews were transcribed verbatim into verbal protocols (VPs). Written notes related to the TA interviews were placed in a separate column next to the protocol text to clarify what occurred during the interview. Protocol analysis (Ericsson & Simon, 1993) was employed for analyzing the verbal data from the TA interviews. Protocol analysis is considered a valuable method of gaining insights into cognitive processes (Fonteyn & Fisher, 1995; Fonteyn et al., 1993; Lundgrén-Laine & Salanterä, 2010). To facilitate the protocol analysis, the verbal protocols of statements were first reviewed and categorized into segments that represented a single focus of attention (Ericsson & Simon, 1993). Next, the verbal protocols were imported into QSR NVivo 10 (QSR International, 1993) to facilitate the analysis. The protocol analysis was conducted using the following three steps (Ericsson & Simon, 1993; Fonteyn & Fisher, 1995; Fonteyn et al., 1993);

- **Referring phrase analysis (RPA)** – All nouns and noun phrases participants focused on during clinical reasoning were identified and coded as concepts.
- **Assertional analysis (AA)** – The set of assertions (statements and declarations) participants made by forming relationships between concepts to facilitate clinical reasoning were identified.
- **Script analysis (SA)** – The data from the RPA and AA was examined to make inferences about the participants' clinical reasoning, in terms of cognitive processes and thinking strategies used, during patient care in home healthcare clinical practice.

Deductive, inductive and abductive approaches (Polit & Beck, 2010; Strydom & Delanty, 2003) were applied during the three-phased protocol analysis. For example, the verbal protocols were deductively analyzed and sorted according to the three steps of the protocol analysis. However, interpretation and inductive reasoning had to be employed as part of this process to identify and name different kinds of assertions,

cognitive processes and thinking strategies. Abductive reasoning was applied when the Ph.D. student had to move back and forth between induction and deduction.

While the analysis was conducted by the Ph.D. student, the different steps of the protocol analysis were regularly discussed among the members of the research team to ensure accuracy of the results (Polit & Beck, 2010). For example, the other research team members analyzed a sample of the most extensive transcripts to reach an agreement on the identified concepts. In addition, all the identified cognitive processes and thinking strategies were discussed for a final agreement.

Thematic content analysis (Polit & Beck, 2010) was conducted on the semi structured interviews. Data from the individual interviews was used for interpreting data from the TA interviews and to obtain a better understanding of the RNs' clinical reasoning. In addition, the interviews provided background information for Study II concerning the participants' satisfaction with current nursing education and suggestions for improvements.

In paper I, most of the data are presented as text. In addition, the paper provides tables with assertions, cognitive processes and thinking strategies identified through the protocol analysis. Only numerical data like frequency is used concerning the total number of concepts, assertions, cognitive processes and thinking strategies.

5.3 Study II: Development of the SG

Design, development, usability evaluation and finalization of the SG were carried out during the period of fall 2014 to fall 2015. The development team consisted of the Ph.D. student from the Department of Health and Nursing Science (Faculty of Health and Sport Sciences) and four students from the Bachelor Program in Multimedia Technology and Design (Faculty of Engineering and Science). As an intensive care nurse with a master's degree in health informatics, the Ph.D. student was responsible for the educational content of the SG and served as the project manager. The undergraduate students were responsible for the multimedia content such as audio and video clips, and for choosing design, tools, and software for development of the SG. Domain experts from both faculties within UiA and the international members of the research team in Study II and III provided supervision. In addition, the Ph.D. student collaborated with health professionals from clinical practice, for quality assurance of the SG and for provision of actors in the SG's scenarios. The Ph.D. student signed an agreement with managers from the home healthcare office and the hospital to hire the two RNs to contribute toward the development of the SG. In return, the two institutions would be permitted to download the SG files into their learning and

management system (LMS). In addition to the two RNs, a person with COPD was recruited from the Norwegian association for heart and lung disease to contribute as a participant in the SG. The actors contributed with medical equipment/medication for use in the video recordings. Provision of other resources and costs were shared between the two faculties.

Development of the SG was based on results from Study I, theory and research related to SG design, experiential learning theory and decision-making theory (Section 2.4.3 and 3.2.1). In addition, the Ph.D. student had to obtain evidence-based knowledge about treatment and care for patients with COPD. The SG should aim to teach nursing students clinical reasoning and decision-making skills (Section 2.2) in care for patients with COPD. Thus, the SG should include the following learning objectives: increase nursing students' awareness and confidence in clinical situations; promote systematic assessment of patients; improve recognition of patient deterioration; and choose appropriate interventions in specific situations. Hence, it should promote development of the knowledge, skills, and attitudes required to deliver safe and competent care to patients with COPD in clinical practice. Based on background knowledge and inputs from the RNs from clinical practice, the Ph.D. student constructed a storyboard for each of the four video-based SG scenarios (Kaczmarczyk et al., 2015; Olsen et al., 2011). Each storyboard contained detailed description of the SG story, educational content, actions in each video clip with related quiz-based tasks, and questions with answers. The quiz-based tasks and questions were constructed based on the situations and cues provided in the scenarios, and were designed to promote testing and increase of clinical reasoning and decision-making skills among nursing students (Section 3.2.1). Examples of questions were; "Based on the information and cues provided by the patient, what assessments and measurements would you conduct on this patient?", "How do you judge Mr. Torp's condition based on his normal values and the information you now have obtained?" and "What are necessary nursing interventions and medical treatment?" The students also had to use a tool named ISBAR (Identify, Situation, Background, Assessment and Recommendation) (Struksnes, Hofmann, & Ødegården, 2015) to aid safe communication of patient information to other health professionals. In addition to testing students' knowledge and skills, the SG tested their attitude through provision of different answering options. For example, in questions related to choosing appropriate actions during acute deterioration of the patient, answer-options like quit smoking and weight loss were added. In addition, participants had to choose between the option to

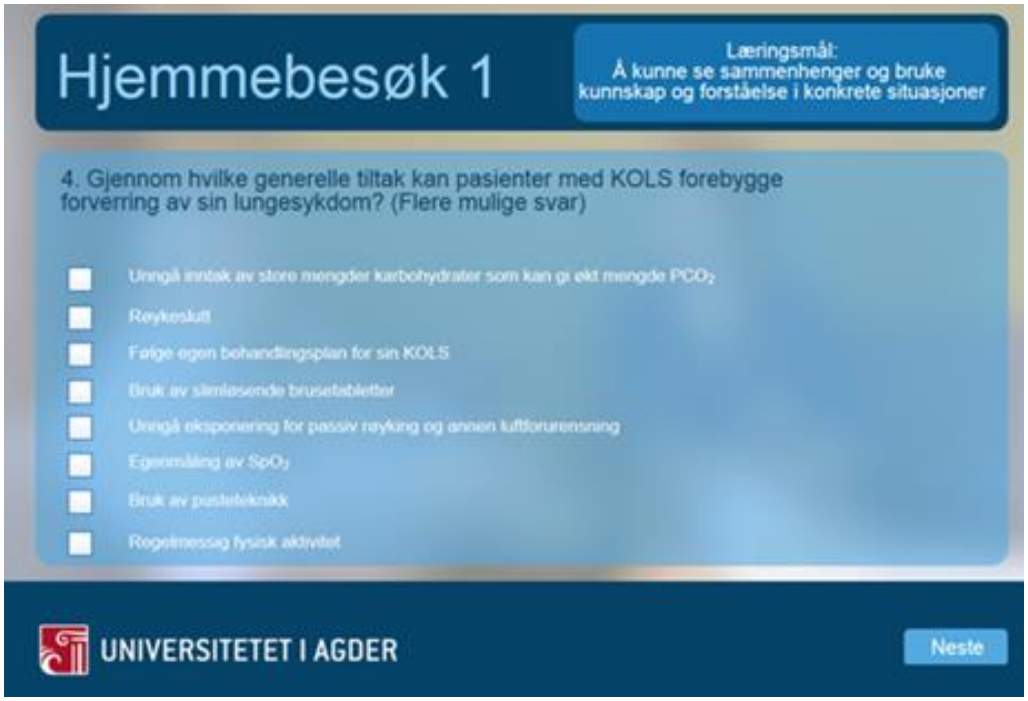
stay with the patient to calm him and provide nursing care, or to give the patient instructions for self-treatment and come back later.

The content of the storyboards was reviewed by a teacher from the Bachelor of Nursing program, members of the research team, the RNs from clinical practice and a physician that is a specialist in treatment of patients with COPD. The four storyboards were used as manuscripts (Figure 3), but were adjusted in accordance with the actors' subjective experiences and suggestions, or due to practical issues. The actors were requested to improvise if necessary. Videos from home healthcare were recorded at a nursing home facility, and the videos from the hospital setting were recorded in the simulation laboratory at UiA.

Figure 3: Screenshot depicting how the storyboard was used as a manuscript during development of the SG. The nurse is adjusting her microphone.

The undergraduate students assembled video clips and questions, and integrated these with necessary information and instructions on how to use the SG. The SG was named "Jeg får ikke puste" (I cannot breathe). The first complete version of the SG contained only the first scenario from the home healthcare setting. Three more scenarios were developed for the final SG prototype, after a usability evaluation was conducted on the first scenario. Figures 4, 5 and 6 show screenshots from the SG, and Table 2 provides a comprehensive description of the SG.


"Jeg får ikke puste"
En læringsressurs til bruk for sykepleiere i møte med pasienter med KOLS
UNIVERSITETET I AGDER
Neste


Hjemmebesøk 1
Læringsmål:
Å kunne se sammenhenger og bruke kunnskap og forståelse i konkrete situasjoner
4. Gjennom hvilke generelle tiltak kan pasienter med KOLS forebygge forverring av sin lungesykdom? (Flere mulige svar)
Unngå inntak av store mengder karbohydrater som kan gi økt mengde PCO_2
Røykeslutt
Følge egen behandlingsplan for sin KOLS
Bruk av slimløsende brusetabletter
Unngå eksponering for passiv røyking og annen luftforurensning
Egenmåling av SpO_2
Bruk av pusteteknikk
Regelmessig fysisk aktivitet
UNIVERSITETET I AGDER
Neste

Figures 4-6: Screenshots from the SG

Table 2: A comprehensive description of the SG

Category	Item	Description
Rationale	Target users	Bachelor of Nursing students (health personnel in clinical practice)
	Objectives	Increase clinical reasoning and decision-making skills to nursing students who care for patients with COPD; • Increase students' awareness and confidence in clinical situations • Promote systematic assessment of patients and identification of patient deterioration • Choose appropriate interventions in specific situations
	Setting	A home healthcare and hospital setting The same patient is followed from he is diagnosed to he has a severe COPD
Game	Genre	Simulation game that mimics a real work environment - users take part in an RN's visits to a patient with COPD
	Graphics	Video-based scenarios
	Interaction	Visual, audio and physical (mouse or touchpad)
	Immersion/ Challenge/ Knowledge acquisition	Quiz-based questions and tasks are presented during each scenario (Interactive design). These are based on patient information and cues provided during the scenarios Drag and drop, single or multiple answer questions (shuffled answers) - Points provided for correct answers with final score Embedded assessment and feedback
	Players	Single player SG
	Rules	Only one attempt is allowed for each task or question. Need to solve tasks or questions to continue with the scenario Correct answers are provided through demonstration by the RN in the scenario. In addition, correct answers may be made to appear on the screen by clicking a button at the lower right corner at the bottom of the screen. The SG is linear – users cannot direct the RN and change paths based on their choices. Users are not able to harm the patient as a result of poor choices.
	User instruction	A tutorial with users' instructions was provided up front in the SG
	Platforms	Personal computers, laptops and the newest tablets
	Software programs	Development: Adobe captivate 8, Adobe Premiere Pro CC, Adobe Photoshop CS6 (Adobe Systems Incorporated, San Jose, CA, USA) Programming and uploading to internet: HTML5 (World Wide Web Consortium, Cambridge, MA, USA)
	Link	http://kurs.uia.no/sykepleie/kols/
Educational content	Content	Tasks and questions in the SG scenarios are based on evidence-based knowledge and the Bachelor of Nursing curriculum. The SG is quality assured by health professionals.
	Construct	Formulation of questions was guided by theory in education, decision-making and human computer interaction

5.4 Study II: Usability evaluation of the first SG scenario

5.4.1 Sample and setting

Study II included a convenience sample (Polit & Beck, 2010) of six participants: two RNs from home healthcare settings, two third-year nursing students, and two university teachers from the Bachelor of Nursing program. The number of participants included is considered an acceptable sample as long as the aim of the usability evaluation is to identify usability issues and flaws in order to improve a prototype (Lazar et al., 2010). The three groups of participants were all considered potential users of the SG. In addition, teachers and RNs would be capable of identifying flaws concerning the content of the SG and the alignment with curricula and clinical practice. The two teachers and third-year students volunteered to participate after the Ph.D. student had announced the project and need for participants. The two RNs from home health care were recruited by their manager, as were the ones that were available at the time of the usability evaluation. One of these participants had contributed in the development of the SG. Efforts to minimize this conflict is described in Section 5.7.1. All six participants took part in a usability evaluation of the SG in UiA's usability laboratory.

5.4.2 Methods

The usability evaluation of the SG included a cognitive walkthrough evaluation, observation, a paper-based survey and a follow-up interview with each participant.

Cognitive walkthrough and observations

Cognitive walkthrough is a method used to explore how users interact with a graphical user interface for the first time, to identify where and why problems occur and which areas need improvement (Lazar et al., 2010). Prior to the cognitive walkthrough sessions, each participant was instructed to vocalize their thoughts if they were having difficulty, and vocalize any questions or comments while playing the SG (Appendix 2). All user interactions with the SG during the session were audio- and video recorded. This also included all user activities on the test computer screen.

Survey

The paper-based survey (Appendix 3) was developed based on 12 items from the validated instrument called the Post-Study System Usability Questionnaire (PSSUQ). This is a research instrument specifically developed for use in scenario-based usability evaluations (Fruhling & Lee, 2005; Lewis, 2002). The original PSSUQ questionnaire

contains 19 items or declarative statements where participants need to select a level of response according to a Likert scale from 1 to 7. In a Likert scale, each scale step indicates how much a participant agrees or disagrees with a specific statement (Polit & Beck, 2010). Scale steps can either be categorized (i.e., strongly agree, agree, etc.), presented as integer numbers with only extreme responses defined, or presented with both categories and numbers (Lazar et al., 2010; Polit & Beck, 2010). Like the PSSUQ, the survey contained a Likert scale with 7 response options. However, instead of using number 1 as strongly agree, the more logical structure: strongly disagree (1) to strongly agree (7) was applied, as higher scores generally are associated with positive response (Polit & Beck, 2010). Like the original PSSUQ scale, only the two scale steps strongly disagree (1) and strongly agree (7) were defined.

Additional statements were added to the survey and some statements were modified based on research on usability evaluation of SGs and the different elements of the TURF framework (Section 3.2.1). A pretest of the survey instrument (Polit & Beck, 2010) was conducted with four colleagues from the Faculty of Health- and Sport Sciences, resulting in rephrasing, adding and removing some questions. For example, the term 'interface' was found difficult to understand and had to be rephrased. Questions about position and experience with computers and e-learning resources were added, and redundant questions were removed. In contrast with the original PSSUQ, two statements were changed from positive to negative. Adding both positively and negatively worded statements may reduce response set bias, such as the tendency to consistently express extreme attitudes (i.e., strongly agree or strongly disagree) or to agree or disagree with statements regardless of their content (Polit & Beck, 2010). All questions were discussed among the research team members until agreement was reached. The final survey instrument included 24 open- and closed-ended questions (Polit & Beck, 2010), containing 20 statements about the SG. Since the PSSUQ instrument was already in the public domain, no permission was required from the developer to use or translate items from the PSSUQ into Norwegian.

Semi structured interview

A semi structured follow-up interview was conducted with each participant. The interview guide (Appendix 4) was developed in collaboration with the research team and contained the following questions: 1) "What did you like best about the system?" 2) "What did you like least about the system?" 3) "Can you recommend any changes to improve this system?" 4) "Would you recommend this way of learning to others?" and 5) "Any other comments?" The participants were encouraged to point out specific

issues on the SG screen during the interview. Some of the participants also took the opportunity to comment on their responses to the survey that was included in the usability evaluation.

5.4.3 Procedure

The usability evaluation was conducted spring 2015 and involved both in-game and postgame assessment (Mayer, Bekebrede, Harteveld, Warmelink, Zhou, Ruijven, Lo, Kortmann, & Wenzler, 2014) of the first SG scenario. The cognitive walkthrough evaluation, observation, post-test usability questionnaire and a follow-up interview with each participant were conducted in the usability laboratory of the Centre for e-health and Care Technology at the UiA. The evaluation team consisted of the Ph.D. student (moderator) and the four undergraduate students from the Bachelor Program in Multimedia Technology and Design. The evaluation team familiarized themselves with the equipment in the laboratory before conducting the usability evaluation. In addition, a pre-test of the usability evaluation was conducted on a research fellow from the Faculty of Engineering and Science (Figure 7) to test the equipment, the SG pilot version and to practice being a moderator (Olsen et al., 2011).

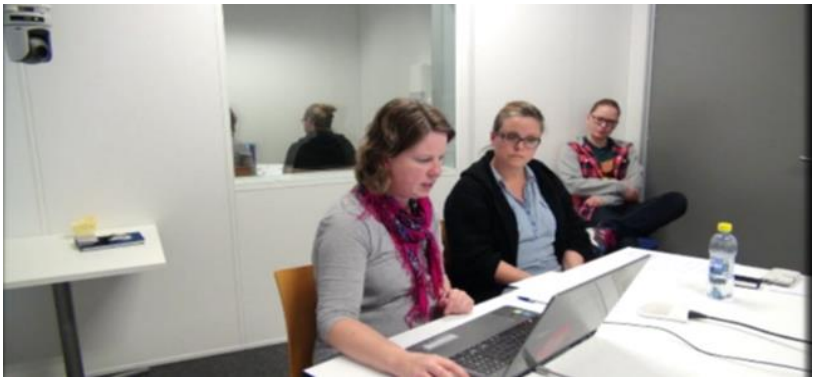


Figure 7: Picture from the pre-test of the usability evaluation in the usability laboratory

Information and instructions about the usability evaluation were provided to the study participants before the procedure started. Paper II provides a detailed description about the usability evaluation procedure, how the data was collected and the results. The results from the usability evaluation was used to improve and finalize the SG prototype.

5.4.4 Analysis

All audio and video-based data from the cognitive walkthrough evaluations and semi structured interviews were transcribed verbatim by the Ph.D. student. A pre made coding scheme (Polit & Beck, 2010) was used to analyze the recorded videos to capture usability issues concerning the specific tasks and questions presented during the scenario, time used to complete the scenario, time used to complete the different questions and number of errors made. However, the aim of registrations of time and errors was not to examine the participants' knowledge, but to identify questions that seemed difficult, complex or may have caused errors. In addition to using this coding scheme, all transcribed data from the usability sessions were imported into QSR NVivo 10 (QSR International, 1993). A deductive content analysis was conducted according to the four elements of the TURF framework and the Nielsen-Shneiderman heuristics (Section 3.2.1). Due to a limited number of participants (n=6) in the survey, only descriptive statistics (Bland, 2000) like frequencies (n), medians (md), and range were employed when analyzing and describing the survey data. The results from the analysis were reviewed and discussed within the research team. The structure of the TURF framework was employed when presenting the results in Paper II. Most of the results from the qualitative data collection are presented in the paper as text, with only numeral data such as time and frequency.

5.5 Study II: Finalization of the SG prototype

Improvements to the SG prototype were conducted based on usability issues identified during the usability test (Moreno-Ger et al., 2012), and what the undergraduate students found was possible to conduct within the scripted version of the Adobe Captivate 8 software. In the process of finalizing the SG prototype, the following adjustments were made: visualization of important information to increase the ease of use of the SG; adding the ability to pause and go back and forth; redesign of the task regarding COPD medication; increase size of letters in questions and tasks; rewording of certain questions, and additional instructional and descriptive text to prevent misinterpretation. The Ph.D. student hired one of the undergraduate students to conduct the final adjustments and prepare the SG for the web-based pilot testing. The final SG prototype contained two scenarios from a home healthcare setting and two scenarios from a hospital setting.

5.6 Study III: Pilot study

5.6.1 Sample and setting

The pilot study included a convenience sample of 249 nursing students across two campuses in the second year of their Bachelor of Nursing program. The gender and age distributions of the participants were representative of nursing students in Norway (Kårstein & Aamodt, 2012). The participants were provided with an access link to the SG in conjunction with two simulation courses in the Bachelor of Nursing program: one for students attending home healthcare clinical placements and one for students attending clinical placements in medical-surgical wards in hospitals.

5.6.2 Methods

The pilot study included a survey (Appendix 5) specifically developed for this study. It included questions and statements based on previous research on evaluation of serious and virtual games (Buttussi, Pellis, Cabas Vidani, Pausler, Carchietti, & Chittaro, 2013; Kaczmarczyk et al., 2015) and other types of simulation (Feingold, Calaluce, & Kallen, 2004; Levett-Jones, McCoy, Lapkin, Noble, Hoffman, Dempsey, Arthur, & Roche, 2011). Since the main aim of Study III was to assess nursing students' perception of the SG's educational value, most of the survey items covered different aspects of face, content and construct validity, that is, the SG's degree of realism/authenticity, alignment of content and tasks with curricula, and the SG's ability to meet the learning objectives. In addition, the survey items covered elements like usability, individual factors and preferences of future use of the SG in the Bachelor of Nursing program. Most of the survey items were categorical variables that represented positively and negatively worded statements, where participants had to respond according to a Likert scale with the six options "I do not know" (0), "strongly disagree" (1), "disagree" (2), "neither disagree or agree" (3), "agree" (4), and "strongly agree" (5).

The survey was reviewed by the members of the research team and was pretested (Polit & Beck, 2010) by four colleagues from different disciplines within health or social sciences to ensure its content and construct validity. Some questions about participant characteristics were added, some misleading statements rephrased, and some statements removed to reduce the number of questions. All questions were discussed among the members of the research team until agreement was reached. The final survey instrument contained 51 open- and closed-ended questions that covered

both participant characteristics, perception of the SG's educational value, usability and preferences of future use.

5.6.3 Procedure

The pilot study was conducted in December 2015. The final SG prototype was integrated in a two-week simulation course for preparing nursing students for clinical placement in home healthcare and in surgical or medical wards in hospitals. Depending on which clinical placements the students were to attend, they were asked to view either the two scenarios from the home healthcare setting or the two scenarios from the hospital setting (figure 8).

Figure 8: Screenshot of the SG showing the available scenarios from the home healthcare and hospital setting

Before the intervention was conducted, information about the SG and intervention was disseminated electronically through the university's LMS and in classroom gatherings. In addition, the Ph.D. student and teachers were available to answer any questions about the content or use of the SG during the study. By the end of the second simulation week, a paper-based survey was distributed to the students either in the simulation unit (for practical reasons) or in relation to a classroom gathering on campus. Students returned their survey in specific boxes that were

distributed among different locations on campus. Students, who had not had the time to view the scenarios during the simulation week were allotted more time and were given an envelope to post their survey.

5.6.4 Analysis

Study III employed both descriptive and inferential statistics (Bland, 2000). The Likert scale responses were treated as discrete ordinal data, and only non-parametric statistical tests were used for inferential analysis (Bland, 2000). The Wilcoxon-Mann-Whitney-U test and The Kruskal-Wallis test were employed for comparing agreement with statements between the different groups of students and in relation to frequency of using games or e-learning and students' work experience (Bland, 2000). Inferential analysis was not conducted on gender, age or the frequencies of use of non-nursing specific e-learning resources due to small group sizes. A p-value less than 0.05 was regarded as statistically significant after Bonferroni-Holm adjustment for multiple tests on the separate group of variables (Bland, 2000). In addition to inferential analysis, the 95% confidence interval (CI) of the proportion of (strong) agreement and (strong) disagreement of participants was calculated on each statement (Bland, 2000). For example, the response options "agree" and "strongly agree" were categorized as positive agreement. Hence, the proportions of (strong) agreement and (strong) disagreement represented composite categories of "negative agreement" and "positive agreement." If the value of the 95% CI of a composite category was ≥ 60%, this was considered to reflect a majority of the students. Other types of descriptive statistics included in this study were frequencies (n), proportions (%), means (m), medians (md), range, inter-quartile range (Q1, Q3) (Bland, 2000). Numerical data that was not normally distributed (i.e., ages of participants) was presented as median, range and inter-quartile range (Q1, Q3). The Statistical Package for Social Sciences, version 22 (SPSS, Inc., Chicago, IL, USA) was used to facilitate the analysis. Thematic content analysis (Polit & Beck, 2010) was employed on data from the open-ended questions. The results from the survey and inferential analysis were reviewed by a statistician who pronounced them sound.

In paper III, most of the results from the survey are presented through tables and figures using the types of descriptive statistics described above. The results from the inferential analysis are presented using text, p-values and proportions (%) of agreement or disagreement. Finally, the general comments from the open-ended questions are presented as text. CI is used when discussing the results.

5.7 Methodological considerations

Verification procedures should be applied during the whole research process to identify threats to reliability and validity (Morse, Barrett, Mayan, Olson, & Spiers, 2002; Polit & Beck, 2010).Verification procedures employed in this project will be described below. Methodological considerations concerning reliability and validity of results will be discussed at the end of the thesis.

5.7.1 Qualitative methods

Verification strategies in qualitative research include investigator responsiveness, methodological coherence, theoretical sampling, sampling adequacy and saturation, and an active analytical stance (Morse et al., 2002).

In Study I, a concurrent TA method, including protocol analysis and additional personal interviews, was employed to ensure methodological coherence and to meet the aims of the study. As an example of responsiveness, the Ph.D. student gained necessary knowledge about clinical reasoning, the TA method and the three-step protocol analysis prior to the study. In addition, both the doctoral student and the participants practiced the TA method before the TA interviews were conducted. The interview guide (Appendix 1) was developed in collaboration with the members of the research team to ensure the questions aligned with the aims of the study and the Ph.D. project. Eight RNs were followed over three visits to achieve sampling sufficiency and to reach the point where no new information could be obtained by further data collection (saturation) (Polit & Beck, 2010). For an active analytical stance, the verbal data was collected, transcribed, and analyzed concurrently.

In Study II, necessary background knowledge was acquired prior to design, development and usability evaluation of the SG. For example, the Ph.D. student visited a specialist on serious games at the Medical school in Sheffield, UK, to gain knowledge about SG design and development. In addition, the doctoral student attended an online Ph.D. course on research methods in user-computer interaction design held by a usability specialist from the University of Nebraska, USA. To ensure credibility in the design and evaluation processes, these two specialists contributed as members of the research team in Study II and III, and as co-authors on paper II and III. Consequently, all the materials (i.e. SG tasks/questions and data collection tools) and data from the design and evaluation processes were translated into English. Furthermore, the design of the SG was based on theory and research related to SG design, experiential learning theory and decision-making theory (Section 2.4.3 and 3.2.1). In addition, health professionals ensured the quality of the SG content.

For responsiveness regarding the SG usability evaluation in Study II, a pretest of the usability evaluation was conducted to test the equipment and practice being a moderator. For methodological congruence, a combination of data collection methods was employed to provide comprehensive data on the SG's usability. The evaluation procedure and the interview guide in Study II were developed in collaboration with the members of the research team to ensure that the study aligned with its aims. To ensure confirmability and credibility of data collected from the usability evaluation, all data collection was conducted in the test room. This would enable the participants to comment on survey responses, add additional comments and point out possible flaws or ideas for improvements on the SG screen. Six participants (students, RNs and teachers) were included in the usability evaluation to provide sampling adequacy and saturation of different potential future users. One of the participants that took part in the usability evaluation had contributed in the development of the SG. To prevent a possible positive bias because of her participation, she was specifically requested to conduct an objective and critical evaluation of the SG. In addition, she was asked to ignore her own acting in the video-based scenarios.

5.7.2 Quantitative methods

Verification strategies in quantitative studies are employed to design reliable and valid instruments. Important aspects to ensure the validity of instruments are face validity, content validity, and construct validity (Polit & Beck, 2010). Face validity concerns whether an instrument measures the appropriate construct or theme. Content validity concerns "the degree to which an instrument has an appropriate sample of items for the construct being measured and adequately covers the construct domain" (Polit & Beck, 2010, pp. 377-378). Construct validity concerns whether the instrument measures the abstract concept of interest. Widely used instruments for measuring usability of general software fall short when applied to SG applications. (Moreno-Ger et al., 2012; Olsen et al., 2011). For example, many of the principles used in usability evaluations of general software are not necessarily applicable to SGs. Furthermore, these instruments focus on various aspects of usability and do not include aspects important in SG design, such as degree of realism/authenticity, alignment of content and tasks with the curriculum, and the SG's ability to meet the learning objectives. Thus, to ensure face, content and construct validity of the survey instruments in Study II and III, questions were based on previous research on evaluation of serious and virtual games (Buttussi et al., 2013; Kaczmarczyk et al., 2015). In addition, questions that particularly aligned with the aims of this study were gathered from validated survey

instruments (Feingold et al., 2004; Levett-Jones et al., 2011; Lewis, 2002). Since data from the agreement scale in Study III were to be treated as categorical ordinal data that cannot be normally distributed (Bland, 2000), it was not found appropriate to calculate reliability coefficients (i.e., Cronbach' s alpha) to validate the survey instrument (Svensson, 2001). However, a pretest of the survey instrument (Polit & Beck, 2010) was carried out in both Study II and III with four colleagues from the Faculty of Health- and Sport Sciences, UiA. In addition, all questions were discussed among the members of the research team until agreement was reached.

5.8 Ethical considerations

All the three studies were conducted in accordance with general guidelines and principles for research ethics (The Norwegian National Research Ethics Committees, 2014a). The project was approved (Appendix 6) by the Norwegian Centre for Research Data (NSD) (project number no. 38298). For Study I, II and III, all participants received written and verbal information about the studies, possible disadvantages and advantages of participating, assurance of anonymity, and contact information (Appendices 7-9). All participants who contributed in Study II and III were also informed that their responses to quiz-based tasks and questions in the SG and their final score would be kept confidential. For Study I and II, the participants signed a written informed consent (Appendices 7 and 8). In Study III, participants consented to participate in the study by voluntarily answering the survey.

Since no verbal data from patients was to be transcribed or used in Study I, neither approval from the Regional Research Ethics Committee (Decision number: 2014/791) nor a signed agreement was required from patients to permit TA interviews in patients' homes. However, the RNs informed patients about the doctoral students visit to their home, the purpose of the interview, and any potential risks prior to obtaining verbal consent from the patients. In addition, the Ph.D. student signed a confidentiality agreement with each home healthcare district to enter patients' homes. The Ph.D. student informed the patients and RNs when the tape recorder was turned on. The patients were also made aware that the nurse was asked to think aloud during the visit. To avoid stressing the RN or patient, the doctoral student did not take any written notes during the visit. Field notes were written after each interview in relation to the concurrent transcription of data.

In Study II, approval was obtained from the ward manager of the nursing home to conduct video recordings in one of their apartments. No confidentiality agreements were required for the Ph.D. student and the undergraduate students before entering the

nursing home. All persons who contributed by acting in the scenarios signed a consent that the videos and pictures could be used for educational purposes within and outside the university (Appendices 10 and 11). Permission to use pictures from the pre-test of the usability evaluation was also obtained.

The undergraduate students' contribution in the SG usability evaluation and collection of data in Study II was approved by NSD. Participants were informed about their roles in the study. The undergraduate students signed an agreement with the Ph.D. student that they could not publish any data from this study.

5.9 Ethical challenges

To keep your integrity as a scientist you are committed to act in accordance with your formal role and responsibility as a researcher. In addition, you are obligated to act in the best interest of research subjects and avoid harm to them (Israel, 2013; The Norwegian National Research Ethics Committees, 2014b). Ethical challenges arose during all the three studies. The most important ones will be presented in the two sections below.

5.9.1 Using the TA method in patient's homes

An important ethical dilemma arose around conducting TA interviews in patients' homes: Would I as a researcher lead the nurse's focus away from the patient? To act in the best interest of both the nurse and the patient, I asked the patient and the nurse to pretend I was not present. In addition, to prevent drawing attention to myself, I placed myself in the background so as not to draw attention away from the nurse, and I refrained from taking any notes during the sessions. Nevertheless, in some situations I found myself in an ethical dilemma when patients started communicating with me. To be true to the TA technique, my role as a researcher was to be an observer and not to intervene in the interview process. However, according to ethical guidelines (Israel, 2013; The Norwegian National Research Ethics Committees, 2014b), patients should be treated with respect and should be our first consideration. Consequently, I allowed myself to give short but polite answers but did not personally encourage such communication.

Due to an acute situation that occurred during one of the think-aloud sessions, I again had to step out of the neutral observer role as a researcher. During one visit to a patient who had suffered a stroke, the patient had trouble getting from the toilet over to her chair. She started to get dizzy and was afraid she would faint. To avoid potential harm to the patient, I assisted the RN to get the patient safely into her wheelchair. In

situations like this, general rules may not be applicable, and one simply has to do what is right under the unique circumstances involved (Israel, 2013).

During TA sessions in patients' homes there is a possibility that patients may be stressed by hearing the RNs' thoughts, or may become anxious if the RN thinks aloud about signs of deterioration of the patient's health. Thus we might ask ourselves whether conducting 'think-aloud' interviews in patients' homes aligns with the principle of acting towards patients in a way consistent with human dignity and worth (Israel, 2013). I trusted the RNs to act in the best interests of their patients. In three cases, RNs chose to omit things they thought might be stressful for patients to hear. No RNs or patients expressed any discomfort related to the TA sessions. On the contrary, many of the patients enjoyed the extra attention of having a Ph.D. student in their home. The RNs expressed that these TA sessions had been useful. They became more aware of their own thoughts, as they got a chance to put their thoughts into words. It made them reflect more on what they do and why they do it.

5.9.2 Development and evaluation of the SG

It is proposed to be a benefit for students' learning to see the consequences of making clinical errors (Kaczmarczyk et al., 2015; Koivisto, Multisilta, Niemi, Katajisto, & Eriksson, 2016; Tiffany & Hoglund, 2014). This means that having the patient in the SG get worse or die due to incorrect actions on the part of the users may provide increased realism and learning. Two video-recordings were conducted showing the patient losing consciousness due to users' incorrect decisions. However, it was decided not to use these recordings out of consideration for the RNs and the patient actor. As the nurse actors play themselves and intend to act as role models in the SG, it would not be ethical to show the RNs demonstrating incorrect actions or allowing the patient to die. This decision is in accordance with Laamarti et al. (2014), who propose that one should avoid negative consequences in an SG deriving from users' low performance. Thus, the SG was designed and developed in an ethical manner (Vivekananda-Schmidt, 2013), where the RNs in the scenario act in accordance with ethical regulations and moral behavior.

Ethical challenges also arose in the SG evaluations in Study II and III. The researcher (Ph.D. student) had contributed in the development of the SG. In addition, the researcher recruited participants from her workplace. The different roles represented conflicts of interests. For example, being a researcher, one is obligated to act in accordance with ethical guidelines and in the best interest of research subjects (Israel, 2013). On the other hand, being the developer and a doctoral student, one is

also interested in obtaining a high response rate and positive responses from the participants regarding the SG. However, allowing the interests of the developer and Ph.D. student to come first may create ethical issues regarding recruitment and may cause bias in the results (Israel, 2013). For example, to be a colleague or acquaintance of the researcher may influence participants' self-determination or feeling of freedom to participate in the study (Israel, 2013; Polit & Beck, 2010). Furthermore, knowing the moderator may cause discomfort among participants (Polit & Beck, 2010), and it may be difficult to make independent judgments about the SG. Participants may feel pressured to respond positively when voicing their perceptions of the SG. To prevent any unwilling consent to participate in the two studies, participants had to volunteer on their own. Moreover, to prevent false positive responses, participants were asked to be honest and critical about the SG.

6.0 RESULTS

6.1 Study I

6.1.1 Sample

The participants in Study I were women aged 22 to 52 years (median 24, mean 27), who had been practicing nursing for between 11 to 12 months, holding a 52% to 100% position. All eight participants had previous work experience as nurse's aides in home health care, nursing homes, or other healthcare-related institutions while earning their nursing degree. In addition, half of the participants had other healthcare-related education prior to receiving their Bachelor of Nursing degree.

All participants were followed over three visits to patients' homes (n=24). Table 3 shows an overview of the RNs visits to patients in the selected patient categories. Several of the patients had additional diagnoses, such as heart failure, renal insufficiency and asthma. Six of the 24 patients lived together with their spouse.

Table 3: Overview of the participants' visits to their patients.

Patient category	**Number of visits (n)**	**Length of the home visits (minutes)**		
		Range	Median	Mean
COPD	9	6-24	10	13
Diabetes	9	5-32	15	17
Stroke	6	21-73	48	47

6.1.2 RNs clinical reasoning in home healthcare clinical practice

The referring phrase analysis (Section 5.2.4) identified 40 concepts RNs focused on during clinical reasoning in all three patient groups: action, aid(s), assistance, beverage, choice, clothes, confirmation, correction, elimination, equipment, exercise, explanation, feedback, food, healthcare professional, hygiene, information, inspection, location, measure, movement, pain, patient, plan, prevention, procedure, request, respiration, routine, safety, sign(s), skin, socialization, status, stimuli, test, time, treatment, valuation, and verification. For example, through the referring phrase "Shall we start by changing your analgesic plaster?" the concepts verification, plan, time, action, patient and treatment were identified. The most used concepts within all three of the patient categories were action, patient, verification and confirmation. The specific meanings of the forty concepts are presented in paper I.

The assertional analysis (section 5.2.4) identified five types of assertions (statements and declarations) participants made when forming relationships between concepts to facilitate clinical reasoning. The most frequently used assertion concepts within each of the three patient groups were explanation, patient, sign, and treatment. The assertion concepts were not mutually exclusive. The identified assertions are presented in Table 4.

Table 4: Assertions made when forming relationships between concepts

Assertions	Verbal data	Concepts
Causal[a]	'Your bottom gets a little red when you are sitting a lot'	explanation, patient, sign
Declarative[b]	'You ought to have a new pill now that we dropped this one on the floor'	explanation, plan, action, patient, treatment, routine
Evaluative[c]	'6.8, then your blood sugar is fine today'	measure, patient, test, valuation, time
Indicative[d]	'When you use painkillers, your stomach will not always be working well, and then this mixture is good to have'	explanation, patient, sign, plan, action, treatment
Preventative[e]	'Will you straighten up a bit, x, it looks like you are going to fall off the sofa'	request, patient, action, movement, explanation, prevention, safety

a. Causal assertions form relationships between cause-and-effect.
b. Declarative assertions form relationships between facts.
c. Evaluative assertions form relationships by judging the significance of signs and interventions.
d. Indicative assertions form relationships between patient status and indicated treatment or interventions.
e. Preventative assertions form relationships between actions and patient harm prevention.

The script analysis (Section 5.2.4) identified participants' clinical reasoning in terms of the cognitive processes and thinking strategies participants used during patient care in home healthcare clinical practice. A total of 14 cognitive processes and 12 thinking strategies were identified. The cognitive processes identified are presented in Table 5.

Table 5: Cognitive processes identified from script analysis

Cognitive processes	Verbal data
Assume	'Maybe you have eaten something sweet this evening?' (High blood sugar)
Conclude	'But if you are not having nausea, then I don't think you need these pills for it'.
Confirm	'Yes, I see you are looking much better'.
Control	'I see from the nurse documentation that your blood sugar gets a bit high in the evening'.
Correct	'This medication should be on your medication list'.
Describe	'Look, when I push your skin in with my finger, it leaves a mark on your leg'. (Swollen leg)
Encourage	'Could you wash your face?'
Explain	'We will get you a ball that you can hold in your hand so you will be able to stretch it out and your nails will not harm your skin'.
Gather information	'Do you feel the inhalation is starting to help?'
Judge	'Your left leg is a bit swollen'.
Personal engagement	'I think you are managing this very well by yourself'.
Plan	'I think we will start with the arm that is affected'.
Shared decision-making	'Do you want to take the rest of your pills now?'
Verify	'Does your shoulder stabilizer feel ok?'

The three most frequently used cognitive processes were explain, plan, and verify. The RNs demonstrated use of reasoning through all the five phases of the nursing process, including assessment, diagnosis, planning, implementation and evaluation:

Assessment: The RNs gathered and verbalized (*describe* and *confirm*) information about the patients´ status and signs.

Diagnosis: The RNs requested the patients to clarify (*verify*) their understanding of the patients' signs or problems. In addition, they expressed an opinion (*judge*) based on gathered information, provided necessary clarification (*explain* and *describe*) and expressed completion of their thought processes (*assumptions* and *conclusions*).

Planning: The RNs involved the patients in making *plan*(s) and care-related decisions (*shared decision-making*).

Implementation: To increase patients' independence, the RNs used *personal engagement* to request (*encourage*) patients to engage in ADL activities.

Evaluation: The patients were engaged in judging effects of treatment or intervention, as the RN *gathered information* from patients about their present versus earlier status, or asked them to *verify* or *confirm* the effect of treatment/interventions. Evaluation also occurred through *control* and *correction* of patient information.

To support their clinical reasoning, the RNs employed different thinking strategies (heuristics) to consolidate patient information and existing knowledge (e.g., knowledge gained from education and experience from working with specific patients or patient groups). The most frequently used thinking strategies were searching for information and providing explanations. The less frequently used were making assumptions, drawing conclusions and pondering. The 13 thinking strategies used by the RNs and employment are presented in Table 6.

Table 6. Thinking strategies identified through the script analysis.

Thinking strategies	Employment during clinical reasoning
Drawing conclusions	RNs made decisions or formed opinions based on gathered information (i.e., these blue marks on your arm must be from the insulin shots)
Forming relationships (assertions)	RNs formed relationships between different concepts when making assertions (preventative, evaluative, causal, indicative, and declarative)
Making assumptions	RNs presumed or supposed different things based on experience (i.e., It is probably too warm for you to wear this wool sweater today)
Making decisions	RNs' decision-making was collaborative. They verified their plans with patients or gave them opportunities to choose between plans (if appropriate).
Making judgments	RNs made judgments in relation to assisting patients and assessing the value of signs, measures, and interventions. Ethical judgments and judgments regarding prescriptions, actions, and statements were also used. Within all patient groups, the most common way of making judgments involved assessing the value of signs, measures, or interventions
Making personal connection	RNs used compliments, personal feedback, and humor to connect with patients. Some also shared personal opinions and made use of self-irony.
Making predictions	RNs used signs (pattern recognition), knowledge, and experience to make predictions about need of certain actions or interventions (e.g. patients with diabetes were predicted to have poor skin, which required regular assessment of the patients' skin to prevent cracks and ulcers). However, this strategy varied among the RNs and was enacted less frequently than others.
Making priorities	RNs set priorities regarding the planning of patient care and time for medication administration. However, this only occurred to some extent.
Pattern recognition	RNs employed pattern recognition when caring for the different patients (e.g. the RNs were particularly aware that stroke victims might have balance problems or might easily fall).
Pondering	RNs sometimes paused after beginning a sentence or simply stated 'let me see'.
Providing explanation	When RNs interpreted gathered information, signs, or measures, they provided patients with information about plans and treatment.
Providing patient safety	RNs' predictions about possible patient harms led some RNs to think about patient safety improvement by planning preventative actions.
Searching for information	RNs gathered information from patients about their perceived status and possible signs. RNs requested patients to verify their understanding of status and signs, planned actions, and understanding of patients' replies or choices. Gathering information by direct assessment and inspection was most frequently used for patients with poor and damaged skin (e.g. patients with diabetes and some with stroke). Direct assessment was used less frequently for patients with COPD.

In the follow-up interviews, participants were asked if they had avoided speaking aloud during the think-aloud sessions out of consideration for the patients.

Three situations were pointed out where participants chose to filter out information from their concurrent verbal reports. In one case, an RN chose not to think aloud when she noticed that one of her patients who had suffered a stroke had become somewhat worse. The patient's mouth-sag and limp on the right side had become worse. This was an elderly patient with an unstable condition for which they had no further treatment to offer. The RN chose not to think aloud about the signs of deterioration because she did not want to upset the old woman. In another case, a patient with diabetes had eaten a lot of sweets the night before and the blood sugar level was higher than usual. The RN chose not to repeat the information about being careful with what you eat as a diabetic, as she had told the patient this many times before. In the last case, the RN felt it would have upset the patient if she had thought aloud about his present condition, when there was nothing new to mention about this patient's condition.

During the interview, the RNs were also asked whether they thought their experiences with these patient groups and individual patients influenced their clinical reasoning. All participants indicated that it was a great advantage to have acquired practical clinical experience with patients within the selected patient categories before or/and during their formal nursing education. This enabled them to detect any signs of deterioration and provide patients with appropriate care and treatment. Having knowledge and experience about patients with COPD was emphasized as particular important. Two of the RNs expressed that they wished they had more experience with patients with COPD. Having prior experience with the individual patients was considered a great advantage to their performance of clinical reasoning. The RNs also argued that if they knew a patient well, they could determine whether a patient would easily or rarely provide information about their deterioration. With this information, they knew whether they should be more aware in terms of particular patients. However, one RN claimed that knowing patients well could also decrease awareness. For example, if the nurse did not act professionally, the home visits might tend to become more social than clinical.

6.1.3 RNs' experience with current nurse education and suggestions for future improvements

In the follow-up interview, the RNs were also asked questions concerning their experience with current nursing education, and ways in which future nursing education might best prepare graduate RNs for their transfer to clinical practice. All the RNs were satisfied with the amount of clinical practice in current nursing education. However, they expressed that many of the clinical placement settings did not provide

any experience with patients within the selected patient categories. In addition, during the period of clinical placement, they seldom got to experience deteriorating patients. As one of the RNs expressed: “What you get to experience in your clinical placement is very random”.

Most of the RNs were satisfied with the theory they had been provided in the nursing education program regarding the three patient categories. However, one of the RNs thought too much of nursing education was dedicated to nursing theories or social science. The RNs proposed that more simulations (laboratory and procedures) and practical experience should be provided in future nursing education. It should particularly include the ability to practice making decisions and act in acute situations. Some RNs also pointed out that watching other RNs in “action” before acting themselves was one of the best ways of learning. Less use of Power-Points and more use of videos were also proposals for future nursing education.

6.2 Study II

6.2.1 Sample

Information about age and years of experience of the six participants was not collected due to the possible risk of identifying the teacher participants. Only information about computer skills and prior experience with different e-learning resources was collected. In the study sample, five of the participants judged their computer skills to be average and one above average compared to other students/colleagues. In addition, four of the participants had previous experience with nursing-specific e-learning resources. However, only one had experience with e-learning resources similar to the SG.

6.2.2 Results from the usability evaluation of the first SG scenario

The participants spent between 27 and 40 minutes, with an average time of 32 minutes to complete the SG scenario. Results from the survey are presented in Table 7, and the usability issues identified through the usability evaluation and interviews are presented according to the TURF related usability heuristics (Section 3.2.1) in Table 8.

Table 7. Responses to usability scale statements

Statements:	Median	(Range)
1. It was simple to use this system.	6	(6-7)
2. I was able to efficiently complete the tasks and scenarios using this system.	6	(5-7)
3. I felt comfortable using this system.	6,5	(5-7)
4. It was difficult to learn to use the system.	1	(1-6)
5. The information (such as online help, on-screen messages, and other documentation) provided with this system was clear.	5,5	(4-6)
6. It was easy to find the information I needed.	6	(3-7)
7. The information provided for the system was easy to understand.	6	(6)
8. The information was effective in helping me complete the tasks and scenarios.	6	(6-7)
9. The organization of information on the system screens was clear [a].	6	(3-6)
10. The interface of this system was pleasant.	7	(6-7)
11. This system has all the functions and capabilities I expect it to have.	5,5	(3-7)
12. The sequence/flow of the tasks in the scenarios was appropriate.	7	(6-7)
13. The system provided informative feedback during the scenarios [a].	6	(3-7)
14. The healthcare related concepts provided in the system were easy to understand.	5,5	(5-7)
15. The learning objectives in the scenarios were difficult to understand.	2	(1-3)
16. The tasks presented in the scenarios were clinical relevant.	7	(6-7)
17. The tasks in the scenarios had an adequate level of complexity.	6,5	(6-7)
18. Overall, I am satisfied with this system.	6	(5-7)
19. Overall, I find the content of the system relevant for use in nursing education.	7	(6-7)
20. Overall, I find the content of the system relevant for use in healthcare organizations.	7	(6-7)

Scoring was based on a Likert scale from 1; Strongly disagree, to 7; Strongly agree.

[a] n=5.

Table 8. Usability heuristics and issues identified during usability evaluation and interviews[a]

Usability heuristics	Issues identified during usability evaluation and interviews
Consistency and minimalism	Some specific screens (i.e., the screen about medications and interventions) were perceived to have too much information, and the text sometimes was a bit small. One participant proposed choosing another color for the buttons and messages at the bottom of the screen so they would be more visible and catch the users' attention more easily.
Visibility and documentation	One participant stated that *"there should be a demonstration in the Introduction on how to use the buttons for viewing correct answers and measures."*
Match	Two cases of mismatch between tasks or questions and the scenario were noted. The patient was prescribed only three of the six medications in the presented task, and the temperature in one case was improperly taken because the nurse merely placed a hand on the patient's forehead.
Memory	Five of the participants had trouble remembering what they had read in the Introduction about the ability to view measures and correct answers during the scenario. Furthermore, two participants had trouble remembering what they had answered in some of the questions about observations and interventions because of the large amount of possible answers.
Feedback and closure	One participant reported that she missed an explanation from the nurse on what she was going to do and why. Another participant wished for an explanation on why the correct answers were more correct than others. Participants' need to view their own answers varied. One stated that she needed to view her own answers to be able to learn from them. Another participant stated that she would prefer to view the correct answers without being reminded of her own mistakes. Three of the participants proposed showing correct and incorrect answers with green and red marks on the screen.
Flexibility, undo, and control	Some participants wished for the ability to solve the same task or question several times, go back to review their answers, and pause or move forward in the scenario.
Message and error	Only one of the participants noticed the message on the bottom of the screen saying that they could not undo their answer.
Language	Five of the participants misinterpreted the first question in the scenario. One of the participants stated: *"The abbreviation of medication names was confusing because I have never used them before."* One of the participants said she had trouble understanding one of the questions because she was not Norwegian.

[a] Based on Nielsen–Shneiderman usability heuristics (Section 3.2.1)

In relation to the SG content, participants expressed that the SG scenario was realistic and that many important principles regarding care for patients with COPD were present. However, one of the teacher participants thought the length of the SG scenario should be shortened, and that the scenario could be more *"to the point".* Some participants also perceived that several of the answers on tasks concerning observations or interventions might be correct, even if they were not among the correct answers. For example, two participants stated: *"If measuring his blood pressure would not cause harm, I would have done that."*

The teacher participants thought this SG could be a good supplement to training in laboratory and clinical settings. They thought the scenario presented relevant issues regarding patients with COPD that could help prepare students for clinical practice. Lastly, they repeated that it could also be useful for nursing students to watch the communication between a patient and an RN in real situations.

Both student participants stated that it would have been useful for them to play this SG before attending clinical placement in home health care. Neither of the two student participants had any experience with caring for patients with COPD during clinical placement in home health care. One of the students expressed that it was useful to learn through the observation of situations in practice instead of just reading books about it. All participants agreed that they would recommend this way of learning to others.

6.3 Study III

6.3.1 Sample

Out of 249 participants, a total of 141 volunteered to answer the paper-based survey that was distributed on campus. However, 21 of the returned surveys had to be excluded due to being blank or partly blank (n=17) or lacking information on how many times they had viewed the scenarios (n=4). Among the blank surveys, some participants had written a message saying they had not viewed the SG scenarios due to time constraints or technical issues. In total, 120 (48%) of the included sample completed the paper based survey. Demographics of the participants in Study III are displayed in Table 9.

Table 9. Demographics of the participants (N=120) in Study III

Demographics	
Gender, n=118	
Male, n (%)	10 (8)
Female, n (%)	108 (92)
Age (years), n=118, Median (Q1, Q3)	22 (21, 24)
Range	(19–53)
Simulation course, n=120	
Medical/Surgical, n (%)	77 (64)
Home healthcare, n (%)	43 (36)
Campus, n=120	
A, n (%)	62 (52)
B, n (%)	58 (48)

Experience concerning use of games and different e-learning resources varied among the participants. Most of the participants played games fewer than 5 hours a week, 57 (49%), or never, 44 (38%). Similar, the majority used non-nursing specific e-learning resources, 82 (69%), or nursing-specific e-learning resources in nursing education, 91 (76%), under 5 hours a week. However, only 19 (16%) of the participants had used similar e-learning resource as the SG. The e-learning resources reported as similar by these participants were quiz-based resources or traditional e-learning resources that cannot be categorized as virtual or serious games.

Half of the participants had health related work experience prior to nurse education. When it comes to prior work experience with COPD patients, 78 (65%) of the participants had no such experience prior to nurse education, and 46 (38%) had no such experience during clinical placement in nursing education.

The majority of the participants, 92 (77%), had viewed the scenario(s) individually. Others had viewed the scenarios together with other students, 31 (26%), and with help from a teacher, 9 (8%). The participants had viewed one or both scenarios from one half- to four times. Most of the participants had viewed scenario 1, 103 (86%), and scenario 2, 87 (73%), only one time. In addition, not all participants had viewed parts of- or the whole scenario 2.

6.3.2 RNs perception of the SGs educational value, usability and preferences for future use

The distribution of participants' agreement and disagreement with statements concerning face, content and construct validity, usability and preferences for future use are presented in table 10-13. This is followed by a presentation of the most important results from the inferential analysis.

Table 10. Participant responses to statements concerning face validity of the serious game (SG), (N=120)

Face validity:	**Student Responses, n (%)**					
Statements, n (responses)	I do not know	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I perceived the situations in the scenarios as realistic, n=119.	0 (0)	0 (0)	1 (1)	14 (12)	56 (47)	48 (40)
I did not perceive that the environment resembled a real clinical practice setting [a], n=118.	0 (0)	33 (28)	43 (36)	27 (23)	13 (11)	2 (2)
I perceived that the nurse in the scenarios acted authentic, n=119.	1 (1)	0 (0)	1 (1)	19 (16)	61 (51)	37 (31)
I did not perceive that the patient in the scenarios acted authentic [a], n=118.	0 (0)	32 (27)	45 (38)	27 (23)	9 (8)	5 (4)
I perceived that the nurse in the scenarios acted as a good role model, n=118.	0 (0)	0 (0)	2 (2)	19 (16)	62 (53)	35 (30)
Use of video-based scenarios made it easier to relate the scenarios to real clinical practice settings compared to use of written scenarios, n=119.	2 (2)	1 (1)	1 (1)	21 (18)	40 (34)	54 (45)

[a] Negatively-worded statement

Table 11. Participant responses to statements concerning usability and individual factors (N=120)

Usability and individual factors:	**Student Responses, n (%)**					
Statements, n (responses)	I do not know	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I had no trouble learning to use the SG, n=117.	1 (1)	1 (1)	9 (8)	10 (9)	45 (39)	51 (44)
I perceived the SG as engaging, n=118.	1 (1)	3 (3)	10 (9)	25 (21)	58 (49)	21 (18)
I perceived the SG to be difficult to use [a], n=118.	0 (0)	38 (32)	62 (53)	14 (12)	3 (3)	1 (1)
I had acquired enough knowledge to solve the tasks in the SG, n=118.	3 (3)	0 (0)	8 (7)	45 (38)	52 (44)	10 (9)
I did not like using the SG [a], n=117.	0 (0)	29 (25)	55 (47)	24 (21)	4 (3)	5 (4)

[a] Negatively-worded statement

Table 12. Participant responses to statements concerning content and construct validity of the serious game (SG), (N=120)

Content and construct validity:	**Student Responses, n (%)**					
	I do not know	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Statements, n (responses)						
I perceived that the content in the scenarios was related to the curriculum that deals with nursing care of patients with COPD [b], n=120.	0 (0)	0 (0)	8 (7)	5 (4)	69 (58)	38 (32)
I perceived that the tasks in the scenarios lacked relation to the curriculum that deals with nursing care of patients with COPD [a b], n=120.	1 (1)	19 (16)	63 (53)	20 (17)	15 (13)	2 (2)
I perceived the scenarios to be appropriately challenging [c], n=120.	1 (1)	4 (3)	34 (28)	36 (30)	41 (34)	4 (3)
The SG tested my knowledge regarding patients with COPD [c], n=120.	0 (0)	0 (0)	0 (0)	19 (16)	65 (54)	36 (30)
The SG tested my clinical reasoning skills [c], n=120.	0 (0)	1 (1)	3 (3)	23 (19)	72 (60)	21 (18)
The SG tested my clinical judgment skills [c], n=119.	1 (0.8)	0 (0)	2 (2)	26 (22)	75 (63)	15 (13)
The SG did not test my decision-making skills [a c], n=119.	0 (0)	22 (19)	58 (49)	29 (24)	10 (8)	0 (0)
Use of the SG made me aware of what I lack in knowledge about patients with COPD [c], n=119.	0 (0)	0 (0)	2 (2)	22 (19)	74 (62)	21 (18)
Use of the SG has increased my awareness of the need to obtaining both clinical and measurable patient information [c], n=120.	0 (0)	0 (0)	4 (3)	24 (20)	72 (60)	20 (17)
Use of the SG has increased my knowledge about patients with COPD [c], n=120.	0 (0)	0 (0)	4 (3)	20 (17)	62 (52)	34 (28)
Use of the SG has increased my understanding of patients with COPD [c], n=119.	0 (0)	0 (0)	4 (3)	17 (14)	61 (51)	37 (31)
Use of the SG has not made me professionally prepared to meet patients with COPD in clinical practice [a d], n=120.	1 (1)	22 (18)	50 (42)	30 (25)	16 (13)	1 (1)
Use of the SG has made me more confident to meet patients with COPD in clinical practice [d], n=120.	2 (2)	0 (0)	4 (3)	45 (38)	49 (41)	20 (17)
Use of the SG has given me valuable experience regarding nursing of patients with COPD [d], n=117.	2 (2)	3 (3)	3 (3)	34 (29)	62 (53)	13 (11)

[a] Negatively-worded statement, [b] Content validity item, [c] Construct validity item, [d] Transferability item.

Table 13. Participant responses to statements concerning preferences regarding future use of this kind of SGs in nursing education (N=120)

Future use in nursing education:	**Student Responses n (%)**					
Statements, n (responses)	I do not know	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I would prefer to read about patients with COPD in a textbook instead of using this type of e-learning resource [a], n=118.	3 (3)	19 (16)	38 (32)	43 (36)	11 (9)	4 (3)
I would prefer to use this type of e-learning resource instead of attending traditional lectures about patients with COPD, n=117.	2 (2)	10 (9)	15 (13)	43 (37)	35 (30)	12 (10)
I would prefer to use this type of e-learning resource instead of working with text-based case descriptions about patients with COPD, n=117.	1 (1)	3 (3)	13 (11)	40 (34)	42 (36)	18 (15)
I would prefer roleplay-based cases or simulations about care for patients with COPD instead of this type of e-learning resource [a], n=116.	0 (0)	33 (28)	28 (24)	25 (22)	18 (16)	12 (10)
I would prefer to use this kind of e-learning resource in combination with current teaching and learning methods, n=117.	3 (3)	2 (2)	3 (3)	28 (24)	37 (32)	44 (38)
I don't think use of this type of e-learning resource can be a good way for students to revise and consolidate existing knowledge [a], n=117.	0 (0)	39 (33)	54 (46)	22 (19)	1 (1)	1 (1)
I think the use of this type of e-learning resource in nursing education is a bad idea [a], n=118.	0 (0)	38 (32)	61 (52)	17 (14)	1 (1)	1 (1)
This type of e-learning resource is best suited to be used individually, n=118.	1 (0)	5 (4)	17 (14)	47 (40)	39 (33)	9 (8)
This type of e-learning resource is best suited to be used together with fellow students or in groups, n=117.	1 (1)	5 (4)	23 (20)	59 (50)	22 (19)	7 (6)
This type of e-learning resource is best suited to be used together with teachers from nursing education, n=118.	1 (1)	10 (9)	31 (26)	56 (48)	17 (14)	3 (3)
This type of e-learning resource is best suited to be used if the students are given the opportunity to have a debriefing session with teachers from nursing education, n=117.	5 (4)	2 (2)	12 (10)	49 (42)	40 (34)	9 (8)
I will not use this e-learning resource again [a], n=118.	0 (0)	37 (31)	50 (42)	25 (21)	2 (2)	4 (3)
I can recommend use of this e-learning resource to other nursing students, n=118.	1 (1)	3 (3)	4 (3)	23 (20)	48 (41)	39 (33)

[a] Negatively-worded statement

In relation to the statements concerning face validity, between 79% and 87% (The 95% CI >60%) of the participants agreed or strongly agreed with the positive statements, while between 64% and 65% (CI <60%) of the participants disagreed or strongly disagreed with the negative statements. In relation to statements concerning content validity, 90% agreed or strongly agreed (CI 85% to 95%) that the content in the scenarios aligned with curricula, while 69% disagreed or strongly disagreed (CI 61% to 77%) that the tasks in the scenarios lacked relevance to the curriculum of the Bachelor of Nursing program. In relation to statements concerning construct validity, 78% agreed or strongly agreed (CI 71% to 85%) that the SG tested their clinical reasoning skills, 76% agreed or strongly agreed (CI 68% to 84%) that the SG tested their clinical judgment skills, while 68% disagreed or strongly disagreed (CI 60% to 76%) that the SG did not test their decision-making skills. However, only 37% agreed or strongly agreed (CI 28% to 46%) that the scenarios were appropriately challenging. In relation to transferability, a total of 60% disagreed or strongly disagreed (CI 51% to 69%) that the SG had not made them professionally prepared, while 58% agreed or strongly agreed (CI 49% to 67%) that the SG had made them more confident about meeting patients with COPD in clinical practice and 64% agreed or strongly agreed (CI 55% to 73%) that the SG had given them valuable experience.

The majority, 93 (78%), of the participants thought this type of e-learning resource should be developed within nursing education for other patient groups. When the participants were asked what other conditions or diseases they would like to see as a focus of future SGs, heart- and cardiovascular diseases, endocrine disorders (specifically diabetes) and neurological diseases (specifically different types of stroke) were among the most commonly referenced.

In the free-text section of the survey, some participants had commented that they had experienced issues regarding the usability of the SG like, the SG was not available on all platforms, technical issues with sound or graphics and limited navigation options. Some also perceived that the SG lacked sufficient information on how to use the SG, that the length of questions and answers could be reduced, and that the SG scenarios lasted too long. Others expressed that they really liked the SG, and that it was a good way of learning.

No significant differences in agreement or disagreement on statements concerning the SG's face, content, or construct validity were found between students with previous experience in healthcare generally, with COPD patients in particular, or those with no experience. However, significantly more participants ($p=0.04$) in the group with health-related work experience disagreed strongly (42.4%) or disagreed

(45.8%) with the statement “I think the use of this type of e-learning resource in nursing education is a bad idea” than did participants with no health-related work experience (22% and 57.6% respectively). Similarly, significantly more participants (p=0.01) in the same group strongly agreed (47.5%) or agreed (30.5%) that they could recommend the use of the SG to other students, compared to 18.6% and 50.8% respectively in the group with no experience.

Significantly more participants (p=0.038) in the home healthcare simulation course strongly agreed (25.6%) or agreed (62.8%) with the statement “The SG tested my clinical reasoning skills” than did so in the medical-surgical simulation course (13% and 58.4% respectively). In addition, significantly more participants (p=0.006) in the home healthcare simulation course disagreed strongly (31%) or disagreed (50%) with the statement “The SG did not test my decision-making skills” than in the medical-surgical simulation course (11.7% and 48.1% respectively). Some differences were also identified between participants in the two courses regarding preferences of future use. For example, significantly more participants (p=0.042) in the medical-surgical simulation course disagreed strongly (17.1%) or disagreed (39.5%) with the statement “I would prefer to read about patients with COPD in a textbook instead of using this type of e-learning resource” than in the home healthcare simulation course (14.3% and 19% respectively). However, significantly more participants (p=0.018) in the home healthcare simulation course disagreed strongly (38.1%) or disagreed (31%) with the statement “I would prefer roleplay-based cases or simulations about care for patients with COPD instead of this type of e-learning resource,” than in the medical-surgical simulation course (23% and 20.3% respectively).

In relation to participants’ experience with playing games, a significant difference (p=0.046) was found on the statement “I perceived the SG as engaging”: 72.2% of participants who never played games agreed or strongly agreed with this statement, compared to 60% in the group who played games fewer than five hours a week and 62% in the group who played games more than five hours a week. Similarly, significantly more participants (p=0.04) in the group who never play games disagreed or strongly disagreed (90.9%) with the statement “I did not like using the SG” than did the groups that played games fewer than five hours a week (61.1%) and more than five hours a week (56.3%). However, no significant differences were found between the three groups of game experience in relation to preferences regarding the use of SGs in nursing education. Similar, no significant differences were identified in perception of usability in relation to experience with gameplay or use of different e-learning resources.

7.0 DISCUSSION

The overall aim of this project was to study recently graduated RNs' clinical reasoning in clinical practice settings and to use this knowledge to develop and evaluate an SG prototype for teaching clinical reasoning and decision-making skills to nursing students. The results of this project will be discussed in relation to the chosen ontology, epistemology and applied framework for SG design and evaluation.

7.1 RNs clinical reasoning in home healthcare clinical practice

Like Greenwood and King (Greenwood & King, 1995), we found that our participants' performance of clinical reasoning in clinical practice was quite consistent with studies of expert RNs' performance (Paper I). The participants employed both simple and complex cognitive processes and demonstrated the use of inductive and deductive reasoning. However, unlike other studies, we also identified utilization of metacognitive skills and ethical reasoning. Furthermore, participants use of additional and different concepts, assertions and thinking strategies verifies the idea that clinical reasoning is influenced by domain-specific knowledge and context (Banning, 2008a; Fonteyn & Ritter, 2008; Simmons, 2010). The results support evidence, suggesting that clinical reasoning is both subjective and contextually constructed (Fonteyn & Ritter, 2008). Consequently, results from study I will be discussed in relation to both subjective and contextual aspects.

7.1.1 Subjective aspects

Despite the use of complex cognitive processes and thinking strategies, the RNs' discipline-specific knowledge, or "knowledge-based work" (Section 2.3.1), seemed to be dominated more by experienced based knowledge and knowledge derived from patient interaction, and less by evidence-based knowledge. For example, instead of conducting thorough patient assessment based on pattern recognition and proactive reasoning, participants asked patients with COPD about their breathing. Strategic patient assessment (i.e., by gathering clinical information like respiration frequency, chest-movements, pulse, or color of skin) and analysis of patient information, are important steps in identifying (diagnosing) actual and potential patient problems (Alfaro-LeFevre, 2013a). Hence, the results can to some extent support evidence suggesting that novice RNs take a less proactive approach than do more experienced RNs (Hoffman et al., 2009; Loftus & Smith, 2008). However, there may be several reasons explaining this less forward-directed reasoning among the RNs. According to one of the RNs, knowing patients well might decrease the RNs' awareness and

thoroughness in assessing the patient. With reference to the ontology of Heidegger (Section 3.1), decreased awareness may occur if the RNs focus more on the 'being' dimension and less on the 'doing' dimension in nursing (Lykkeslet & Gjengedal, 2006). Another reason explaining a less forward-directed reasoning could be the fact that RNs with one year of clinical practice are still consolidating knowledge and skills (Hoffman et al., 2009; Loftus & Smith, 2008). For example, some participants expressed that what they experienced in their clinical placement during nursing education was very random, and that they seldom were given an opportunity to experience deteriorating patients. Participants also expressed a need for increased knowledge and understanding about patients with COPD. However, we should be careful when drawing conclusions about inadequate evidence-based knowledge among the RNs based on the TA interviews. RNs' less forward-directed reasoning may also have been influenced by a deficit in the ability to apply and integrate various kinds of knowledge during performance of clinical reasoning (Section 2.1), or in their analytic skills (Section 2.2.1). For example, experts and advanced beginners may both have the necessary knowledge in memory in a given situation, but the difference is whether they can access it reliably when it is needed (Ericsson & Simon, 1993). This is in line with Aristotle (Section 2.1) and Heidegger (Section 3.1), who propose that practical knowledge and understanding includes not only the ability of knowing 'what' (theoretical knowledge) and 'how' (procedural knowledge), but also knowing 'when' and 'why'.

Since the RNs did not experience any acute deterioration in patients during their visits, the results cannot support evidence that recently graduated RNs (i.e., one year practice) identify fewer cues than expert RNs (Jensen et al., 2008; Loftus & Smith, 2008; Simmons, 2010). However, one of the RNs did identify signs of deterioration in one of her stroke patients, but chose not to verbalize this so as not to stress the patient. In another case, an RN encouraged a patient to contact his doctor regarding his heart medication because the swelling in his legs had increased. Overall, the RNs' use of complex cognitive processes and thinking strategies, including ethical reasoning, supports the claim that clinical reasoning skills improve as the RNs gain experience in caring for patients within a specific discipline (Banning, 2008b; Benner, 2004; Jensen et al., 2008). However, the participants' use of shared decision-making, personal connection and ethical reasoning is evidence that knowledge organization is not the only way to assess the impact of expertise. As suggested by Loftus & Smith (2008), RNs' expertise also depends on how they interact with patients and contextual factors in natural settings. Thus, the results support the proposition that RNs' should not be

differentiated by their years of experience, but rather by their clinical reasoning skills (Banning, 2008b).

7.1.2 Contextual aspects

Organizational or environmental factors (Hedberg & Larsson, 2004; National Academies of Sciences, 2015) may also have influenced the RNs' clinical reasoning performance. Demographic changes and care reforms have resulted in a shift in healthcare delivery from hospital to home healthcare services, demanding increasingly more complex and efficient care provision (The Ministry of Health & Care Services, 2009; Word Health Organization, 2013b). Consequently, health care has become more market and economy based with a focus on public management that prioritizes productivity, efficiency and profit (Karoliussen, 2011). For example, in this study, the RNs' visits with their patients lasted from 5 to 73 minutes, depending on the patients' conditions and need for help with daily living activities. Patients' need for help and time allocated for each visit is set by a central office within the community services administration (Vabø, 2012). A strict time schedule may constrain RNs and make them more rule-governed so that they conduct only the procedures necessary without seeing the "whole" patient (Karoliussen, 2011). Thus, in reference to the ontology of Heidegger (Section 3.1), there may be more focus on the 'doing' dimension rather than the 'being' dimension in nursing (Lykkeslet & Gjengedal, 2006). In addition to a strict time schedule, there may have been interruptions caused by telephone calls or other staff members during some home visits, and this may have disturbed the RNs' clinical reasoning processes (Hedberg & Larsson, 2004).

Culture may also have influenced the RNs' clinical reasoning. As proposed by Heidegger, we always live in a historical, cultural, and social relation that forms the nature of our being and the meaning of our language (Schmitt, 2000). The RNs' clinical reasoning was highly influenced by discipline-specific and experienced based knowledge. Wackerhausen (2015) proposes that experience based knowledge may often be influenced by culture and habits of a workplace and lead to intuitive but unreflective practice. In line with Heidegger (Schmitt, 2000), Wackerhausen (2015) proposes that such habits of thinking, or (pre) understanding, implicit beliefs and assumptions should be made explicit and changed through analytic reasoning and metacognition. Most of the RNs in this study expressed that the TA sessions had been very useful. They were given a chance to put their thoughts into words, and after the sessions they started reflecting more on what they do and why they do it. These statements indicate that their awareness of self and the world had been strengthened

(Section 3.1). Thus, we might question whether the RNs currently have, or take, time for analytic reasoning or reflection and discussion together with colleagues.

7.2 Educational value of the SG

In this section, the overall educational value of the SG will be discussed in relation to the essential components of educational games: context, user specifications, pedagogy and representation.

7.2.1 Context

Heidegger (Schmitt, 2000) and D. A. Kolb (1984) emphasize that experiential learning occurs through interactions between humans and their environment. Thus, in line with Heidegger's concepts of 'being-in-the-world' and 'dasein', this project developed a video-based SG whereby nursing students should get a sense of "being there" in the real world of clinical practice.

Results from Study II and III showed that the use of videos from clinical practice settings was very important to the participants' perception of the SG's face validity. The results line up with research showing that the graphical aspect of videos makes them effective at creating realism and providing detailed visual information and context (Forbes, Oprescu, Downer, Phillips, McTier, Lord, Barr, Alla, Bright, Dayton, Simbag, & Visser, 2016; Kaczmarczyk et al., 2015; Woodham, Ellaway, Round, Vaughan, Poulton, & Zary, 2015). Furthermore, the results support evidence showing positive experiences in simulations using standardized patients in nursing and medical education (M. Anderson, Holmes, LeFlore, Nelson, & Jenkins, 2010; Kowitlawakul, Chow, Salam, & Ignacio, 2015; Verkuyl et al., 2016). In line with other research, this project found that an SG's degree of realism and resemblance to an actual clinical practice setting is important to its educational value (de Freitas & Oliver, 2006; Graafland et al., 2014; Schijven & Jakimowicz, 2005). However, experiential learning is also dependent on both the quality of the experience and meaningful reflection (Fowler, 2008).

Even if the video-based SG was perceived as realistic, it is recognized that the totally controlled environment in the SG can be a disadvantage when it comes to realism. For example, a real patient in home health care would probably have a more complex health condition. In addition, the absence of challenges like organizational factors (i.e., limitation of time and resources and interruptions) in the SG may reduce the realism by concealing RNs' complex and demanding work in clinical practice.

7.2.2 User specifications

According to Heidegger (Schmitt, 2000), people bring into the world their knowledge and understanding. Thus, it was important to develop an SG with a content that fits the intended users and was relevant to their future work as RNs (de Freitas & Liarokapis, 2011; Graafland et al., 2014; Zhang & Walji, 2011).

The participants reported that the content of the SG was found relevant for both students and RNs working in clinical practice. The participants in study II perceived the SG to have an adequate level of complexity, while the responses from participants in study III varied in relation to the SG being appropriately challenging. However, this varying and disproportionately neutral responses in study III may be explained by individual attributes among the students such as their level of evidence-based knowledge and previous work experience. It was a positive surprise, however, to find no work experience dependence in relation to participants' perceptions of the SG's face, content and construct validity in study III. Positive attitude (mood) towards the SG among participants with prior experience may be explained by the fact that they could identify with the RNs and context in the SG scenarios (Annetta, 2010; de Freitas & Oliver, 2006). It may also be explained by their enhanced ability to recognize cues and patterns better than the inexperienced students (Jensen et al., 2008; Newell & Simon, 1972). This positive result supports evidence suggesting that experiential learning (i.e., through SGs) may help students recognize cues in clinical situations and aid their information-processing (D. A. Kolb, 1984; O'Neill et al., 2005).

In line with evidence (Venkatesh et al., 2016), students' perceptions of the SG as engaging and their attitude (mood) towards the SG were influenced by their previous experience, or lack thereof, with games and e-learning. Likewise, the varying and disproportionately neutral responses to some of the statements concerning use preference of the SG may be explained by the students' wide range in ages, individual needs and learning preferences. However, despite varying and disproportionately neutral responses concerning use preferences, most participants perceived the SG as a good supplement to traditional teaching and learning methods. This result is in accordance with results from other studies (Kaczmarczyk et al., 2015; Kirkley & Kirkley, 2004; López-Pérez, Pérez-López, & Rodríguez-Ariza, 2011).

7.2.3 Pedagogy

The SG's pedagogy will be discussed in relation to the three overlapping dimensions of education and teaching; qualification, socialization and subjectification (Biesta, 2012).

Qualifications:

Acquisition of knowledge and skills, and to a certain extent values and dispositions, are the components of qualification (Biesta, 2012). Thus, for an SG to be educationally valuable, it should prove to facilitate formative assessment, knowledge acquisition and skills development (Girard et al., 2013; Ribaupierre et al., 2014; Wattanasoontorn et al., 2013). The video-based SG supports formative in-game assessment by providing quiz-based tasks throughout the game. The tasks promote testing of user's knowledge, clinical reasoning and decision-making skills through a process of 'reflective observation' (section 3.2.1). Furthermore, the SG facilitates acquisition of knowledge and skills by providing correct answers and demonstrating appropriate actions, which facilitates thinking and 'concrete conceptualization'. In assessment of the nursing students' perceptions of the SG's educational value in study III, the 95% CI of the proportions of agreement and disagreement about the SG's construct validity (study III) showed strong evidence that the SG managed to test and develop their knowledge and skills. The SG also challenged students' attitude (mood) and awareness of self and the world (Section 3.1). For example, most of the participants agreed or strongly agreed that the SG had made them aware of their own lack of knowledge regarding patients with COPD, increased their awareness of obtaining both clinical and measurable patient information, and increased their understanding of patients with COPD. Overall, the results indicated that the SG is pedagogically sound in terms of aligning with its learning objectives (Stott & Mozer, 2016). Furthermore, the results support evidence suggesting that formal assessment through simulations (Ryall, Judd, & Gordon, 2016) and SGs (Adjedj, Ducrocq, Bouleti, Reinhart, Fabbro, Elbez, Fischer, Tesniere, Feldman, & Varenne, 2017) may be effective in evaluating students' overall skills.

One of the main intentions of the SG was that students would be able to transfer what they have learned to other clinical practice situations through 'active experimentation (Section 3.2.1). The two nursing students who participated in Study II, expressed that it would have been useful for them to play the SG before attending clinical placement in home healthcare. These statements correspond with evidence that the use of simulation training in home healthcare visits increases students' confidence

in their ability to complete home visits (Richards, Simpson, Aaltonen, Krebs, & Davis, 2010; Yeager & Gotwals, 2010). However, the 95% CI of the proportions of agreement and disagreement about the SG's educational transferability in Study III indicates no strong evidence that a majority of future student users of the SG will agree that it prepares them professionally or makes them more confident when encountering patients with COPD in clinical practice, or that it provides them with valuable experience. These results do not align with existing evidence suggesting that the use of simulations (Benner et al., 2010; Gaberson et al., 2014), video- or virtual games (del Blanco, Torrente, Fernández-Manjón, Ruiz, & Giner, 2017; Verkuyl, Romaniuk, Atack, & Mastrilli, 2017) increases nursing students' self-confidence and preparedness for clinical placements. However, the results support the assertion that experiential learning through simulation games alone is not optimal (Benner et al., 2010; Gaberson et al., 2014). This was confirmed by the result that most of the students preferred to use this kind of e-learning resource in combination with current teaching and learning methods rather than alone. Similarly, the results suggests that simulation games combined with hands-on simulation is the best teaching and learning practices we can offer nursing students in addition to clinical placement (Verkuyl et al., 2017).

Although the video-based SG was perceived as educationally valuable, it is recognized that the totally controlled environment in the SG may have some limitations. For example, an emphasized focus on assessment and caring for patients with COPD in the SG scenarios may lead the focus away from other important aspects, such as principles of hygiene and psychosocial needs. In addition, the students are not given an opportunity to experience the consequences of incorrect decisions and inappropriate actions. It is also recognized that evidence-based knowledge applied in the SG content may change in the future and should therefore be continually updated. Finally, a limitation of this kind of learning resource compared to classroom simulations is the lack of debriefing after the students have completed the scenario. Debriefing has proven to be an essential component in simulation (Dreifuerst, 2012; Nehring & Lashley, 2009).

Subjectification

Subjectification defines the way in which education contributes to the formation of certain qualities of the individual person (Biesta, 2012). In line with Heidegger (Section 3.1), Lindseth (2015) and D. A. Kolb (1984) argue that cognitive 'crises' or reflections and thinking are premises for learning, and for students becoming

experienced and reasonable individuals. Thus, the SG was designed to facilitate both intuitive and analytic reasoning as well as metacognition (Croskerry, 2013; A. Y. Kolb & Kolb, 2009; Wackerhausen, 2015), in line with D. A. Kolb's (1984) experiential learning cycle and the clinical decision-making model (O'Neill et al., 2005). As mentioned in the previous section, most of the participants in Study III agreed or strongly agreed that the SG was able to test and increase their knowledge and skills. These results support the claim that the deeper any mental content is processed, the more learning takes place (Ericsson & Simon, 1993; Newell & Simon, 1972; Spitzer, 2014).

Fowler (2008) argues that experiential learning is dependent on both the quality of the experience and quality of the reflection, and that there needs to be meaningful interaction or an overlapping of the two. Thus, nursing students' reflection and learning process will also depend on their experiences and perceptions of the SG. This may relate to the SG's ability to create a realistic and relevant context (Section 7.2.1), but also the SG's representation or user-computer interaction design (Section 7.2.4). For example, lengthy and low quality SGs may cause frustration, slow down the pace of problem-based learning and impede users' ability to review and critically appraise the information presented (Winograd & Flores, 1987; Woodham et al., 2015).

According to Heidegger (Schmitt, 2000), moods are self-fulfilling. This means that a lack of sense that one is able or needs to learn something will prevent students from acquiring or exercising a skill. This is in line with evidence suggesting that facilitation of experiential learning and attitude towards learning may be influenced by students' intrinsic motivation (Abela, 2009; Fowler, 2008). For example, some students did not view both scenarios or did not see the scenarios in their entirety. In addition, only about half of the participants in Study III (strongly) agreed that they had acquired enough knowledge to solve the tasks in the SG. In contrast, other students viewed both scenarios and many times. The difference in students' intrinsic motivation supports the need for educators to vary between student-directed and teacher-directed learning strategies to facilitate learning among nursing students. (Abela, 2009)

Socialization

Socialization refers to the way in which nursing students become part of existing traditions and practices (Biesta, 2012). Thus, a video-based SG is designed that includes specific contexts from clinical practice and that demonstrates appropriate (evidence-based) actions and care by RNs. An advantage of using role models in the SG is that the role models act in the best interest of the patient and are not influenced

by personal, organizational or cultural factors. For example, most of the participants in Study III agreed or strongly agreed that the nurse in the SG acted authentic (trustworthy), and as a good role model. In addition, one of the student participants in Study II stated that it was useful to learn through observation of situations in practice instead of just reading about it in books. Furthermore, the participants in Study II perceived that the video-based SG indeed demonstrated the caring relationship between the RN and her patient. In contrast with the video-based SG in this project, other current SGs have been perceived as lacking nursing care aspects (Diener & Hobbs, 2012), as they often focus on teaching acute nursing care (Buttussi et al., 2013; Cook, McAloon, O'Neill, & Beggs, 2012; Liaw et al., 2015). This may support using a role model RN in SGs to demonstrate the proper care and interventions.

There may also be disadvantages in using role models in SGs. For example, the use of role models can be negative if there is too much focus on socialization without adequate attention to subjectification. In this situation, education runs the risk of becoming just another instrument of social reproduction (Biesta, 2012). Another limitation in using role models in an SG is that there is no opportunity for a dialog between the student and the role models. In real clinical practice, preceptorship ensures that nursing students acquire experience on a one-to-one basis through role modeling, questioning and reflection (Myrick et al., 2010). Thus, an SG course provider could facilitate one-to-one or group-based questioning and reflection in relation to or after gameplay.

Socialization in terms of interacting with other nursing students and teachers may also facilitate reflection and experiential learning (Fowler, 2008). Similarly, evidence suggests that interactive online courses, including virtual environments and simulation games, should be used in collaboration with other students and course providers (Ma, Jain, & Anderson, 2014; Moule, Pollard, Armoogum, & Messer, 2015; Stott & Mozer, 2016). In contrast with evidence, most of the participants in Study III chose to play the SG individually, even though they had the opportunity to collaborate with other students while playing the SG. Evidence suggests that too much focus on subjectification or self-directed learning may lead to an exclusion of context and social mechanisms of constructing meaning and knowledge (Biesta, 2012; Taylor & Hamdy, 2013). Thus, the results imply that when implementing TEL (such as SGs) in nursing education, teachers need to help students find the right balance between the dimensions of qualification, subjectification and socialization to facilitate reflection and learning.

7.2.4 Representation

In line with Heidegger's ontology (Section 3.1), Winograd & Flores (1987) propose that the representation (interface design, language/text and graphics) of technology (such as an SG) is essential to the quality of the user-computer interaction. The participants in Study II perceived that the SG was easy to learn, easy to use and likable. However, the usability evaluation revealed usability issues similar to other studies, like; issues with length of videos, complex tasks, lack of ability to skip back and forth in the scenarios (Kaczmarczyk et al., 2015; Moreno-Ger et al., 2012; Verkuyl et al., 2016), color schemes, layout and wording (Moreno-Ger et al., 2012) and technical glitches (Kaczmarczyk et al., 2015; Verkuyl et al., 2016). In addition, the results supported evidence indicating that immersion and motivation may be influenced if the user gets tired, annoyed or frustrated by complex tasks or lack of functionality (Annetta, 2010; Olsen et al., 2011). The development of the SG was a low budget project, where Bachelor of Multimedia technology and design students explored the use of Adobe Captivate 8. The development team experienced that Adobe Captivate 8 did not provide all the functionalities that was planned in designing the SG. Consequently, adaptations (scripts) of the original solution caused some of the usability issues and technical glitches identified in the usability evaluation. Necessary and doable adjustments were made before finalizing the SG.

In evaluation of the final SG in Study III, it was a positive surprise to find no significant differences in perception of usability in relation to experience with gameplay or use of different e-learning resources. In addition, the 95% CI of agreements and disagreements about the SG's usability constitutes strong evidence that future student users will agree that the SG is easy to learn, easy to use, and likable. Perception that the SG was highly usable may have positively impacted students' experience and perceptions of the educational value of the game (Moreno-Ger et al., 2012; Olsen et al., 2011) and user acceptance of the SG (Venkatesh et al., 2016). Furthermore, the positive results support the claim that conducting usability evaluations during SG development is essential (Lazar et al., 2010; Moreno-Ger et al., 2012; Olsen et al., 2011).

7.3 Methodological considerations

7.3.1 Trustworthiness of qualitative data

Some researchers argue that the more broad and abstract concepts of reliability and validity can be applied to all research (Morse et al., 2002). In qualitative research, it is common to assess trustworthiness of studies by using the four criteria developed by Lincoln and Guba (1985): credibility, transferability, dependability, and confirmability (Morse et al., 2002; Polit & Beck, 2010). Credibility refers to "the confidence in the truth of the data and interpretations of them" (Polit & Beck, 2010, p. 492); transferability to whether the results can be transferred to other groups or settings; dependability to whether the study results are replicable, and; confirmability to congruence of data between independent people (Polit & Beck, 2010). In their later writings, Lincoln and Guba added 'authenticity' as a fifth criterion that concerns whether a researcher is able to describe the reality and feeling of participants (Polit & Beck, 2010).

Different verification procedures were applied during the research process to ensure credibility of the qualitative data from study I and II (Section 5.7.1). In addition, results from the analysis were discussed among the members of the research team to ensure credibility of results. The trustworthiness of the qualitative data collected in Study I and II will be discussed below.

The trustworthiness of data collected through TA interviews may be influenced if participants do not self-report all their thoughts during the TA sessions, and if participants verbalize more common social communication by explaining and describing the process instead of thinking aloud. Additionally, some participants may find it easier to verbalize their thoughts than others, and this may influence verbal reports. Furthermore, the RNs' previous experience may have raised participants' level of clinical reasoning skills. For example, half of the participants in Study I had other health-related education prior to nursing education. In addition, all participants had worked as nurse's aides during their formal nursing education. However, data on how long the RNs had been seeing the individual patients was not collected. As this may influence the data collected and their interpretation, future studies should collect information about length of patient-RN relationship.

Caring for patients in home healthcare is a complex process and produced a large amount of verbal data through the TA interviews. The strength of using the three-step protocol analysis was that this systematic method facilitated the identification and examination of the different aspects of clinical reasoning (Section

2.2). Furthermore, this method of analysis adds credibility to the results by providing a means of retracing and explaining results derived from the analysis. The consistent use of the identified concepts, assertions, cognitive processes and thinking strategies by each participant in Study I supported the reliability of the results. Furthermore, correlations with results from other studies concerning clinical reasoning indicate that the results can be transferred to some extent to other groups or settings. However, based on the small number of participants (n=8), the results from the TA interviews cannot be generalized to all RNs in home healthcare. It is also recognized that the choice of three specific patient groups in Study I may influence the transferability of results to other patient groups and settings. In addition, it may be difficult to replicate the results from this study, since the situations and patients were all unique.
To describe the uniqueness of the situations and patients, the use of different qualitative data collection methods in Study I enabled an authentic description of the reality and perceptions of the participants in Paper I.

The use of different data collection methods in Study II provided comprehensive information about how the users perceived the SG. The comprehensive information adds credibility to the study results. For trustworthiness, the qualitative data from the usability evaluation was analyzed deductively using a theoretical framework and usability heuristics (Zhang et al., 2003; Zhang & Walji, 2011). This enabled identification of possible and necessary improvements of the SG prototype. However, since two of the participants in Study II were colleagues of the Ph.D. candidate and one of the RNs had contributed in design of the SG, it is recognized that these participants may have caused a possible positive bias in the results. They may have felt pressured to respond positively when voicing their perceptions of the SG (Section 5.9.2). Furthermore, the small number of participants must be taken into consideration when interpreting the results. However, the results from the qualitative data collection concerning participants' perceptions of the SG were replicated to a large extent in Study III.

7.3.2 Reliability and validity of quantitative data

Two important criteria for assessing the quality of a quantitative study are reliability and validity. Reliability can be defined as "the degree of consistency or dependability with which an instrument measures an attribute" (Polit & Beck, 2010, p. 566). Validity is defined as "a quality criterion referring to the degree to which inferences made in a study are accurate and well founded; in measurement, the degree to which an instrument measures what it is intended to measure" (Polit & Beck, 2010, p. 571).

In Study II and III, verification strategies were employed to ensure face, content and construct validity of the survey instrument (Section 5.7.2). However, although a note was added in Study III to alert respondents that the survey contained both positively and negatively worded statements, the 95% CIs for negative statements did not indicate the same reliability as did those for positive statements. These differences may have been random or caused by a lack of awareness of the negative statements, as research suggests that it takes a longer time to process negative statements than positive statements (Lietz, 2010). The lack of awareness of negative statements represents a possible source of bias in Study III. Hence, our results suggest that negatively worded questions or statements should be avoided (Lietz, 2010). Furthermore, it is possible that bias could have resulted from the fact that not all participants viewed both scenarios

To ensure that most students participated in the study (used the SG), the game was implemented as part of an existing simulation course instead of as a standalone resource. The course coordinators were provided with access to the SG and student information a week before the course occurred. Due to a misunderstanding, the students in the home healthcare simulation course were not provided with this information until the same week when the course started. The limited time available to view the scenarios may have lowered the responses among the students from the home healthcare simulation course compared to the other course. In addition, the fact that half of the students in the home healthcare simulation course were to start their clinical placement in a psychiatric ward may have led to lack of motivation to use the COPD SG and participate in the study, supporting previous evidence that perception of the educational value of the SG and intention to use it will depend on how it fits with the context and current needs of students (de Freitas & Oliver, 2006; Venkatesh et al., 2016).

To ensure reliability of the results from Study II, the results from the analysis were reviewed and discussed within the research team. To ensure reliability of the results from Study III, surveys were excluded that had been left partly blank or did not include information on how many times the participant had watched the scenarios. Furthermore, two members of the research team cleaned and checked all data imported into SPSS (Polit & Beck, 2010) before analysis of results. The choice of descriptive statistics and/or inferential analysis were determined by the sample sizes, distribution of numerical data, properties of the variables, and the aims of study (Section 5.4.4 and 5.6.4). The choice of inferential analysis in Study III was also discussed with a statistician. For example, due to the properties of the variables (statements with ordinal

values), no summarization of scores was conducted for the different group of statements, nor for measures of correlation between the different variables. The results from the analysis in Study II and III were reviewed and discussed within the research team. In addition, the results from Study III were reviewed and discussed with a statistician.

Even if the CI measured in Study III provide indications that future nursing students would find the SG educationally valuable, the sample size and the voluntary nature of the sample must be taken into consideration when interpreting the results (Polit & Beck, 2010). For example, it may be that these survey participants were more motivated to express good or bad experiences with the SG than students at large (Polit & Beck, 2010). However, the gender and age distributions in Study III were representative of nursing students in Norway (Kårstein & Aamodt, 2012).

Although the participants in Study II and III perceived the SG as educationally valuable, further research needs to be conducted on a larger sample to evaluate the SG's effect. For example, this could be conducted using a randomized controlled trial (RCT), where participants are randomly allocated to an experimental (SG) group or a control (non-SG) group, and where a pretest and posttest design could capture data showing change over time of the participants' performance on the target skill(s).

7.4 Contributions of this project

7.4.1 Research:

- To our knowledge, no studies have specifically explored how recently graduated home healthcare RNs use clinical reasoning while caring for patients after one year of experience in clinical practice
- Few studies have employed the three-phased protocol analysis
- Limited research has addressed the design, development and evaluation process of SGs in the domain of nursing education.
- Few studies have focused on assessment of SG's educational value in terms of face, content and construct validity.

7.4.2 Nursing education:

- This research complies with both White Paper 13; Education for Welfare: "Interaction as key" (The Ministry of Education and Research, 2011-2012) and White Paper 16; Culture for quality in higher education (The Ministry of

Education & Research, 2017), because it aims to improve nursing education and especially the transition of nurses from training to practice.

- This SG provides students with the ability to engage in clinic-like learning experiences where they need to learn to use knowledge and practice thinking in changing situations and for the good of each patient (Benner et al., 2010). Hence, the SG emphasizes important aspects of clinical reasoning like systematic assessment and detection of cues or signs that indicate possible patient deterioration (Hoffman et al., 2009; The Ministry of Education & Research, 2012; The Norwegian campaign for patient safety, 2017). The particular aim of increasing students' clinical reasoning skills also complies with recommandations from the National Academies of Sciences (2015).
- The SG may be a supplemental tool for nursing education to promote the development of theoretical-analytical competence, practical competence, learning competence, social competence, and professional ethics competence among nursing students (Kyrkjebø et al., 2002; Råholm et al., 2010).
- To improve the match between RNs´ education and the realities of clinical practice (Word Health Organization, 2013a), this project collaborated with health professionals and integrated knowledge from both home health care and the local hospital in design of the SG.
- This project's focus on knowledge-based practices in design of the SG also complies with White paper 47; The Coordination Reform" (The Ministry of Health & Care Services, 2009).
- Although SGs represent a learner-centered educational approach (Ribaupierre et al., 2014; Ricciardi & De Paolis, 2014), the content of this SG is constructed to bridge the three dimensions of education and teaching; qualification, subjectification and socialization.
- In addition to being applied in nursing education, this SG may serve as a tool for health personnel in home healthcare and hospitals to refresh their knowledge and skills about care of patients with COPD. Further, by promoting increased understanding about clinical practice in both sectors, the SG might decrease boundaries and bridge the gap between home healthcare and hospital practice.

8. CONCLUSIONS

8.1 Main conclusions of this thesis

- RNs with one year of experience employed both simple and complex cognitive processes involving both inductive and deductive reasoning. They utilised metacognitive skills and ethical reasoning. However, their reasoning was more reactive than proactive. In addition, knowing patients well may have both positive and negative effects on clinical reasoning performance.

- The first SG scenario was perceived as being useful, usable, and satisfying. However, the usability evaluation revealed several usability issues that needed to be improved before finalizing the SG.

- Most nursing students perceived the final SG as educationally valuable in terms of face, content, and construct validity, and found it easy to use. They also agreed that more video-based SGs should be developed and used in nursing education, especially in care for patients with chronic diseases.

- The video-based SG scenarios with a person with COPD and RNs as actors contributed toward providing increased realism and enabled a demonstration of the transpersonal caring relationship between the nurse and patient

- The results support the idea that experiential learning through video-based SGs may aid nursing students' clinical reasoning

- The results support the proposition that context, learner specifications, pedagogic considerations and mode of representation are essential dimensions in design and development of educationally valuable SGs.

- The nursing students' positive attitudes towards the SG and wish for similar SGs within other areas of nursing education strongly support further development of this kind of technology-enhanced learning in nursing education. However, SGs should be considered a supplement to, not a replacement for, current teaching and learning methods.

8.2 Implications for practice and further research

The results support the idea that experiential learning through video-based SGs may aid nursing students in their clinical reasoning. However, developers need to ensure SG's ability to facilitate active, experiential, situated, and problem-based learning (Annetta, 2010; Arnab et al., 2015). SGs should be both pedagogically sound and engaging (Stott & Mozer, 2016). In addition, simulation course organizers will be more likely to use an e-learning resource that students perceive as educationally valuable (Tait, Tait, Thornton, & Edwards, 2008). Furthermore, care must be taken, when incorporating SGs into a curriculum, to address issues like integration of the SG into the course plan and material, teacher facilitation of discussion and feedback, easy access to the tool, allocated time, and technical support (Foronda & Bauman, 2014).

Further research should focus on evaluating the SG's effectiveness, for example by conducting an RCT with a pre-and post-test design. In addition, further research should focus on how to successfully integrate SGs as a supplemental tool in nursing education. This may include testing diverse ways of implementing the SG in the nursing program (i.e., group, classroom, or other ways suggested by students). Research may also include the teachers' role in facilitating the development and use of SGs. Furthermore, the results imply that more SG's should be developed within the domain of home healthcare and covering patients with chronic diseases. Here, there is a great potential for further research collaboration between the university and the municipalities with the goal of improving a match between nurses´ education and the realities of clinical practice.

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